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THE VENEZUELAN SALT-FISH INDUSTRIES

FISHERY LEAFLET 240
FISH AND WILDLIFE SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

United States Department of the Interior, J. A. Krug, Secretary
Fish and Wildlife Service, Albert M. Day, Director

Fishery Leaflet 240

Chicago 54, Illinois June 1947

THE VENEZUELAN SALT-FISH INDUSTRIES

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With a Supplementary Report:

STUDIES ON THE CONTROL OF "REDDENING" IN SALT-FISH PRODUCTS

By

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THE VENEZUELAN SALT-FISH INDUSTRIES

INTRODUCTION

Background for the Survey

Early in 1942, difficulties occasioned by the war threatened to cut off, or at least to curtail drastically, the normal supplies of imported salt-fish for the Caribbean area. With immediate action necessary to relieve that deficiency, it was soon realized that very little definite information was available concerning the possibility of supplying all or a part of the local needs for salt-fish products by the expansion of local fishery industries.1/ To provide such information, a field survey of the Caribbean rim countries was completed in October 1942.2/ The reports of the survey party, published by the Office of the Coordinator of Inter-American Affairs, are now available for restricted distribution and may be consulted for supplementary information.3/

As one finding of the above-mentioned study, it was concluded that the marine fisheries of Venezuela offered very definite possibilities for expansion of several fishery industries and especially for the export production of brine-salted and dry-salted fish.

Thus, in a preliminary report to the Government of Venezuela, and also in its final report, the Caribbean Fishery Mission recommended that "improved techniques for the drying and salting of suitable fish be undertaken in order to prepare more acceptable products for export and local consumption. Salted fish * * * * could not be regarded in general as conforming with export standards. Improvements in color and odor should be accomplished easily and would result in a much superior product."

On June 7, 1943, the Ambassador of Venezuela transmitted the following note to the Secretary of State:

(Translation)

No. 2185

Embassy of Venezuela

Washington

The Ambassador of Venezuela presents his compliments to His Excellency the Secretary of State and has the honor to request his good offices with the Fish and Wildlife Service of the United States Department of the Interior in order that the services of an expert in the preparation of salted and pickled fish might be secured to go to Venezuela at the expense of the Venezuelan Government.

In the report submitted by the United States Mission of Fish Experts which recently visited Venezuela, it was recommended that "a mission of experts from the United States should be contracted for the study of the Venezuelan fisheries to assist the Venezuelan Government to organize the administration and development policy." The Government of Venezuela considers that the assistance of the expert is very necessary for the development

1/ The Caribbean area normally imports about 150,000,000 pounds of fish, chiefly dry-salted and brine-salted, from Canada, Newfoundland, the United States, Norway and Iceland.

2/ Financed by funds transferred to the Fish and Wildlife Service by the Office of the Coordinator of Inter-American Affairs. The field survey was conducted by Milton J. Lobell, Fishery Engineer, and Clarence R. Lucas, Fishery Economist, of the Fish and Wildlife Service. Reginald H. Fiedler, who was the nominal chief of the Mission, accompanied the party during its studies in Haiti and in the Dominican Republic.

3/ "The Fisheries and Fishery Resources of the Caribbean Area: With Recommendations for their Expansion and Development." A Report of the Caribbean Fishery Mission, Washington 1943. Mimeographed.

of the national fishing industry, and consequently for the food supply of the neighboring Antilles, due to the fact that the process now used by the Venezuelan industry for the preparation of dried fish does not meet the requirements for exportation, according to the United States Mission. Once the proper process is developed and adopted the Venezuelan fishing industry would be in a position to cooperate in supplying the West Indies which have already begun to benefit from the Venezuelan production and to import considerable amounts of preserved fish products from Venezuela.

Granting the possibility of the loan of the services of the desired expert for the duration of the studies, the terms on which he would be contracted are requested, as well as information concerning the equipment which would be required for the work to be undertaken.

The Ambassador of Venezuela expresses his appreciation to His Excellency the Secretary of State for his good offices in this matter.

Washington, June 7, 1943.

On July 28 the following note was transmitted in reply to the Ambassador of Venezuela by the Secretary of State:

The Secretary of State presents his compliments to His Excellency the Ambassador of Venezuela and has the honor to refer to the Embassy's note No. 2185 of June 7, 1943, concerning the desire of the Venezuelan Government to obtain the loan of the services of an expert qualified to provide technical assistance in connection with the salting and pickling of fish.

The matter has been the subject of correspondence and discussion with the Fish and Wildlife Service of the Department of the Interior, and that organization has indicated that in compliance with His Excellency's request it will be pleased to make available the services of one of its experts * * * to assist His Excellency's Government for a period of approximately two months in the capacity of fishery technologist, under the provisions of the Act of Congress approved May 3, 1939 (Public No. 63, 76th Congress).

* * * * * *

Consideration has been given to the desire of His Excellency's Government to bear the expenses incident to the detail of the expert requested, and in that connection it is suggested that the Venezuelan authorities may wish to reimburse this Government for all expenses incident to (the expert's) salary, quarters and subsistence allowances, and travel from Washington to Caracas and return to Washington. These expenses need not be paid, however, until after the survey shall have been completed, at which time the Secretary of State will render a full accounting to the Venezuelan Government.

The Fish and Wildlife Service has suggested that in order to render the investigations requested by His Excellency's Government complete it would be desirable to have an expert qualified in the field of fishery economics accompany (the expert) to Venezuela and make studies of the capacity of the Venezuelan communities for producing salt-fish, costs of production, and the organization of the production system * * * * it is proposed that these experts study methods for the production, salting, and marketing of various kinds of Venezuelan fish, both from the standpoint of local demand and export possibilities. Among other things, it is suggested that they endeavor to obtain accurate information on the following questions:

1. What salting and drying techniques can be utilized to develop products more widely usable in the Venezuelan fish trade and more suitable for export?

2. What quantities of salt-fish can be produced in Venezuela and what proportions thereof can be made available for export?

3. Within what price limits can salt-fish be produced and exported?

4. Within what period can properly processed fish be produced?

5. What fishing gear and supplies not now available should be provided in order to increase production?

6. What modifications of fishing operations should be effected to increase production?

It is further proposed that the Venezuelan authorities appoint a representative in Venezuela who speaks English to act as liaison officer between the experts and His Excellency's Government and arrange for contacts with fishermen and processors and marketers of salt-fish.

The Fish and Wildlife Service would be pleased if the Venezuelan authorities would also provide transportation for the experts within Venezuela to various important fishing centers including transportation by boat if necessary.

Facilities for conducting fish-salting experiments will be needed during the course of the survey, and in that connection the Fish and Wildlife Service has requested that His Excellency's Government provide a building with an adjoining open yard, located in a fishing community. Such building should contain at least one room not less than thirty feet long and twenty feet wide, with a concrete floor, tap water, electricity, sewer connections, and screened doors and windows. The yard adjoining the building should be suitable for the erection of racks for the drying of fish.

* * * *

Department of State,

Washington, July 28, 1943.

Resume of the Mission's Activities.

The work of the mission began on September 15, 1943, with the arrival of Mr. Lobell at Caracas. Due to certain difficulties Mr. Puncochar was not able to reach Venezuela until October 8. Pursuant to instructions, both members of the mission reported to Ambassador Corrigan on their arrival (September 16 and October 8, respectively).

On September 16, Mr. Lobell called on Dr. Rodolfo Rojas, then Minister of Agriculture and Animal Husbandry (Ministerio de Agricultura y Cria).1/ At his direction the mission was detailed to work with the Fisheries Service (Servicio de Pesqueria) of the Division of Agricultural Economy (Direccion de Economia Agricola).2/

Sr. Benjamin Arriens, the Chief of the Fisheries Service, was appointed liaison officer between the mission and the Venezuelan Government. With his help, official calls were made, an investigative program and itinerary of travel planned, and the compilation of important statistical and factual information commenced. In addition laboratory space was arranged for, certain equipment and supplies secured, and samples of salted and dried fish procured and examined.

With the arrival of Mr. Puncochar on October 8, immediate steps were taken to initiate the field work of the mission. On October 12 the party proceeded to Cumana where the experts were met by Sr. Adolfo Ortega G., Administrator of the Pearl Fisheries. Sr. Ortega was detailed to accompany the mission and to cooperate in carrying out its objectives.

1/ Dr. Rojas was appointed Minister of the Treasury in November 1943.
Dr. Biaggini was appointed to the position formerly held by Dr. Rojas.

2/ Dr. J. A. Gonzalo Patrizi is the Chief of this Division.

Field headquarters were set up in Caiguire, a suburb of Cumana and experiments in salting and brining fish were begun. These studies were continued until October 27 and included an analysis and appraisal of methods employed by the Venezuelan fishermen, as well as of the procedures in general use in other countries of the Western Hemisphere. Also, an experiment was set up to determine if cannery wastes could be sun dried for use as an ingredient in stock feeds.

During the period October 8 to 27 intensive surveys and investigations were made of factors influencing the capacity for production, present and potential, in the Cumana area, including the Gulf of Cariaco, the Araya Peninsula, Isla Tortuga, and the entire coast between Cabo Codera and Cumana (also Unare Lagoon and many of the off-lying islands near Guanta). Important salt works at Araya were visited and information was obtained as to capacity of the plant and quality of the salt produced. Practically every fishing camp (rancheria) of any consequence was visited and literally hundreds of fishermen were interviewed. Actual fishing operations were witnessed on many occasions and the mission was able to follow the flow of fish from the water through the salting and drying operations to the final sale. Although the mission was concerned primarily with salt-fish products, cannery enterprises were visited and information was obtained relating to quantity and quality of production. Data were secured relative to barrel and box making, marketing, warehousing, shipping, labor, boat building, sanitation, fishing supplies, costs of production, and on other relevant factors.

From October 28 until November 3 the mission was based at Porlamar, Isla Margarita. Studies as to actual production were made, comparable to those in the Cumana area,—rancherias all around Isla Margarita, on Isla Coche, Isla Cubagua, and at Chacopata were visited. Experimental work in the utilization of several very abundant species for salting was carried on. These species, namely the thread herring (machuelo) and scad (chicharra) are abundant seasonally, but are not caught because no market for their sale exists at present. Data were secured relating to abundance, migrations, and seasonal occurrence of important species, and on production and costs. At Porlamar a third fish cannery was visited, and information was obtained relating to fish-meal processing and canned-fish production.

From November 3 until November 8 the surveyed area was extended from Chacopata eastward to Rio Caribe. From Rio Caribe the party returned to La Guaira by sea, stopping at Carupano, Porlamar, Cumana, and Puerto de La Cruz.

On November 18, after approximately two weeks in Caracas, the field party, accompanied by Sr. Arriens, proceeded westward by sea. Important fish-producing regions, present and potential, were visited--particularly in the Paraguana Peninsula. Information of the type described above was obtained and experiments on fish salting and drying were conducted. The important centers of Puerto Cabello, Las Piedras, Los Taques, La Mocolla, Punta de Cardon, Zazarida, Amuay, Carirubana and others were visited. The party arrived in Maracaibo on November 28 and worked in the region until December 4. During this period numerous trips were made to various fishing centers on the Lake, including Isla Toas, Punta de Palma, Altagracia, Sabaneta de Palma and Maracaibo itself. Some experimental fishing with a small shrimp trawl built by the mission was carried on and catches were made of shrimp and flounders. Inquiries were made regarding lumber, box and barrel-making facilities, salt production, operating and other costs. Many samples of locally produced salt-fish were examined and experimental packs of salt-fish were prepared.

The mission returned to Caracas by automobile on December 5. From this date until December 10 the mission conferred with officials of the Venezuelan and United States Governments and made arrangements for departure. On December 10 the party left for La Guaira where samples of dry salt and brine salt-fish were prepared for shipment to the laboratory of the Fish and Wildlife Service at Mayaguez, Puerto Rico, for further study.

Certain technological problems (bacterial reddening) affecting the keeping quality of salt-fish products as prepared in Venezuela, made it necessary to undertake additional investigations. Samples of Venezuelan salt were shipped to the Puerto Rican laboratory of the Fish and Wildlife Service and chemical and bacterial studies, together with experiments covering control measures are now in progress. Preliminary indications are that efficient methods for the solution of the reddening problem can be developed.[1/]

1/ Preliminary results of these investigations are embodied in various sections of this report. Additional studies are reported in Supplement I to this report.

Mr. Lobell left on the morning of December 11 for Miami and Mr. Puncochar departed in the afternoon of the same day for Puerto Rico, via Trinidad.

The majority of the time in Venezuela was spent in the field. Thus, field operations in eastern Venezuela occupied 28 days, and field operations in western Venezuela, 18 days. Every fishing center of consequence from the Goajira Peninsula to Rio Caribe was visited. All of the travel by sea was accomplished on vessels of the Fisheries Service--the Nueva Esparta and the Goajira. In addition, accessory activities, such as salt works, fish canneries, barrel and box-making facilities, ice plants and others were studied. Sample packs of various species of fish were prepared to determine methods, keeping qualities, and possible price structures.

Acknowledgments

It is impossible to over-emphasize the importance of the excellent cooperation and assistance extended by the Government of Venezuela through the Ministry of Agriculture and Animal Husbandry. It augurs well for the continued success and growth of the fishing industry that officials and employees of the Fisheries Service were able to arrange the itinerary and working equipment of the mission so efficiently.1/ No less cooperative were the members of the Venezuelan fishing industry and many others. The Ambassador to Venezuela, Dr. Frank P. Corrigan, and his staff assisted the members of the mission in countless ways.

PART I

THE PRESENT CONDITION OF THE SALT-FISH INDUSTRIES

PRODUCTION

Over-all statistics of the production of fresh and salt fish have been collected by the Government of Venezuela since 1940 and compilations are published annually by the Ministerio De Agricultura y Cria. They provide an excellent basis for estimating the total catch. The data are secured directly by employees of the Servicio stationed at a number of important fishing localities. Officials of the Servicio de Pesqueria calculate that the published statistics represent from 50 to 60 percent of total production. In order to calculate the production of fish as landed "in the round," the figures for salt-fish have been multiplied by four in order to compensate for losses in weight due to cleaning and salting. To convert kilograms to pounds the weight in kilograms was multiplied--2.2.

The poundages of all fish as landed in the round recorded were:

1940.....	71,826,980 pounds
1942.....	81,771,449 pounds
1943.....	61,553,454 pounds (for first 6 months)

The published totals, however, are incomplete since data for the following are lacking:

1. Minor fishing localities not covered by Servicio employees.
2. Fresh and salt fish locally consumed by fishermen and others.
3. Fish carried by truck from isolated landing points to interior towns.

In the following analyses, an arbitrarily estimated amount of 30 percent, to compensate for the catches probably made or utilized as above and not recorded, has been added to the published totals.

Since maximum production is during the first six months of the year, it is estimated that the 1943 figure given above (61,553,454 pounds) represents about two-thirds of the probable total catch for the entire year. On that basis it may be expected that the total

1/ The Fisheries Service of the Venezuelan Government has also agreed to furnish the mission with a detailed compilation of statistical data and this will be used to prepare a subsequent report.

for 1943 was approximately 82,000,000 pounds. If we add to the above figures the estimated 30 percent to take into consideration the unreported portions of the commercial catches, the estimated grand total production was as follows:

1940..... 93,375,920 pounds
1942..... 106,302,886 pounds
1943..... 107,000,000 pounds (calculated for whole year)

Table 1 - Production and Value of Salt-Fish Reported to the Venezuelan Fisheries Service During the Years 1940, 1942, and 1943 (first six months)

Zone	1940		1942		1943	
	Kilos[1]	Bolivares[2]	Kilos	Bolivares	Kilos	Bolivares
Western	1,099,455	540,225	781,335	508,186	1,940,299	1,419,399
Central	755,743	647,815	476,195	280,368	83,397	59,271
Eastern	4,386,618	2,540,800	6,354,625	3,671,750	3,938,164	2,308,819
Total	6,241,816	3,728,840	7,612,155	4,460,304	5,961,860	3,787,489

The summaries in Table 1 give the amount and value of fresh and salt-fish for 1940, 1942 and the first six months of 1943 as published by the Ministerio. The various zones listed in the table are defined as follows:

Western Zone: Colombian border eastward to Punta de Chichirivichi.
Central Zone: Punta de Chichirivichi to mouth of the Unare River.
Eastern Zone: Mouth of the Unare River to Punta Playa (Delta Amacura).

Table 2 - Production and Value of Fresh-Fish Reported to the Venezuelan Fisheries Service During the Years 1940, 1942, and 1943 (first six months)

Zone	1940		1942		1943	
	Kilos	Bolivares	Kilos	Bolivares	Kilos	Bolivares
Western	1,192,049	713,877	826,200	542,761	422,518	276,383
Central	932,690	1,000,292	679,727	674,205	368,141	440,682
Eastern	5,556,622	2,387,232	5,214,290	1,718,417	3,340,744	1,369,684
Total	7,681,361	4,101,401	6,720,217	2,935,383	4,131,403	2,086,749

Tables 1 and 2 disclose that the eastern zone produces the bulk of the fish landed. The western zone is second in rank, and the central zone, last. Calculated as percentages, the contributions of the various zones are denoted in Table 3.

Table 3 - Contributions of Various Zones to Total Recorded Production During the Years 1940, 1942, and 1943 (first six months)

Zone	1940	1942	1943 (first six mo.)
	Salt Fish		
	Percent	Percent	Percent
Western	17.6	10.2	32.5
Central	12.2	6.4	1.1
Eastern	70.2	83.4	66.4
	Fresh Fish		
Western	15.5	12.3	10.3
Central	12.2	10.2	8.9
Eastern	72.3	77.5	80.8

TABLE 4 4/

GENERAL RESUME OF THE PRODUCTION 1/ AND VALUE 2/ OF FRESH AND SALT FISH IN THE REPUBLIC - 1942

SPECIES	CENTRAL ZONE				WESTERN ZONE				EASTERN ZONE				TOTAL			
	Fresh		Salt		Fresh		Salt		Fresh		Salt		Fresh		Salt	
	kilograms	Bolivares	kilograms	Bolivares	kilograms	Bolivares	kilograms	Bolivares	kilograms	Bolivares	kilograms	Bolivares	kilograms	Bolivares	kilograms	Bolivares
aguja	140	58.50	-	-	-	-	-	-	-	-	-	-	140	58.50	-	-
anchoa	-	-	18,700	12,020	-	-	-	-	146,383	62,559	260,715	138,819.60	146,383	62,559	279,415	150,839.60
arenque	-	-	-	-	-	-	-	-	1,434,500 3/	144,140	-	-	1,434,500	144,140	-	-
armadillo	-	-	-	-	4,081	2,686.85	652	345	-	-	-	-	4,081	2,686.85	652	345
atun	380	380	-	-	-	-	-	-	12,934	6,459	-	-	13,314	6,839	-	-
bacalao	-	-	-	-	-	-	-	-	92	54.99	-	-	92	54.99	-	-
bagre	-	-	-	-	4,253	1,886.20	280	155	10,720	2,862.97	50,453	26,367	14,973	4,749.17	50,733	26,522
bergantin	-	-	-	-	-	-	-	-	-	-	160	40	-	-	160	40
blanco	65,988	59,585	-	-	-	-	-	-	-	-	-	-	65,988	59,585	-	-
blanquillo	8,669	6,360.35	-	-	-	-	-	-	-	-	-	-	8,669	6,360.35	-	-
bocachico	-	-	-	-	44,399.25	23,191.85	93,386.50	53,156.70	-	-	-	-	44,399.25	23,191.85	93,386.50	53,156.70
bonita	-	-	-	-	343.50	229.35	1,630	732	35,888	14,651.50	37,045	16,198.82	36,231.50	14,880.85	38,675	16,930.82
burro	-	-	-	-	-	-	-	-	18	11.25	-	-	18	11.25	-	-
burrito	-	-	-	-	-	-	-	-	21,318	8,775.55	4,726	1,926.40	21,318	8,775.55	4,726	1,926.40
cabana	-	-	14,100	5,750	-	-	-	-	31,234	11,600	225,310	138,064	31,234	11,600	239,410	143,814
cabrilla	-	-	-	-	-	-	-	-	10	7	-	-	10	7	-	-
cachicato	4,165	3,048.60	100	100	-	-	-	-	-	-	-	-	4,165	3,048.60	100	100
cachorreta	-	-	-	-	-	-	-	-	13,998	6,999	11,856	6,238	13,998	6,999	11,856	6,238
cachua	80	40	-	-	-	-	-	-	-	-	-	-	80	40	-	-
cagalona	-	-	-	-	300	60	-	-	7,119	2,802.97	3,133	1,493.20	7,419	2,862.97	3,133	1,493.20
camaron	-	-	-	-	52	75.25	-	-	500	25	-	-	552	100.25	-	-
camburito	20	20	-	-	-	-	-	-	-	-	-	-	20	20	-	-
canario	-	-	-	-	-	-	-	-	6,712	2,035.79	3,817	1,923.25	6,712	2,035.79	3,817	1,923.25
carite	90,897.50	101,594.80	300,457	184,852	44,380	26,070.04	69,835.50	37,515.40	926,243	482,539.43	938,344	650,354.12	1,061,520.50	610,204.27	1,308,636.50	892,721.52
carpeta	-	-	-	-	13,789	7,575.95	-	-	-	-	-	-	13,789	7,575.95	-	-
carrachana	-	-	3,000	1,825	-	-	-	-	86,345	23,312	121,335	58,399	86,345	23,312	124,335	60,225
cataco	-	-	-	-	-	-	-	-	52,920	24,992.65	165,607	99,344.15	52,920	24,992.65	165,607	99,344.15
catalana	-	-	-	-	-	-	-	-	13,675	6,841	-	-	13,675	6,841	-	-
catalufa	1,649	874.75	-	-	-	-	-	-	-	-	-	-	1,649	874.75	-	-
cazon	410	410	60	60	351.50	213.75	107,331.25	67,110.65	158,859	52,236.50	482,214	226,975.79	159,620.50	52,860.25	589,605.25	294,145.44
cojimua	2,525.50	2,664.65	-	-	-	-	-	-	43,117	21,635	26,471	16,660	45,642.50	24,299.65	26,471	16,660
corocoro	12,724.50	7,130.40	100	75	250	75	-	-	272,186	117,606.77	956,348	464,659.80	285,160.50	124,812.17	956,448	464,734.80
coti	-	-	-	-	315	136.95	214	176	-	-	-	-	315	136.95	214	176
cuna	-	-	-	-	-	-	-	-	83,607	60,961.75	52,304	37,472.12	83,607	60,961.75	52,304	37,472.12
cunaro	360	360	-	-	58,273.725	29,065.83	-	-	6,557	3,305	344,018	239,967.75	59,190.725	32,730.83	344,018	239,967.75
curbina	-	-	-	-	19,672	12,691.80	309,686	190,779.90	39,978	10,946	80,150	9,028	59,650	23,637.80	389,836	199,807.90
curbinata	-	-	-	-	-	-	-	-	32,788	15,415.80	5,112	2,842	32,788	15,415.80	5,112	2,842
cherna	-	-	-	-	1,300	1,160	1,871	1,161	-	-	-	-	1,300	1,160	1,871	1,161
chicharro	35	17.50	-	-	692	259	500	500	20,324	9,679	177,678	93,794	21,051	9,955.50	178,178	94,294
chipiron	71.50	74	-	-	-	-	-	-	-	-	-	-	71.50	74	-	-
chucho	-	-	-	-	30	15	1,908	772	135	84.37	960	660	165	99.37	2,868	1,432
doncella	-	-	-	-	495	315.30	6,172	4,751	-	-	-	-	495	315.30	6,172	4,751
dorado	289	140	-	-	355.50	249.09	-	-	5	1.25	-	-	629.50	390.34	-	-
guanapo	3,145	2,285.90	-	-	-	-	-	-	25,394	9,907	-	-	28,539	12,192.90	-	-
guasa	76	60.80	-	-	-	-	-	-	2,350	1,317.67	-	-	2,426	1,378.47	-	-
jurel	1,279	966.10	105,950	51,850	30,542.42	23,662.23	11,466	9,207.70	262,133	84,652.60	687,128	337,816.40	313,954.42	111,280.93	804,544	398,874.10
jurelete	-	-	-	-	-	-	-	-	14,765	6,783.40	120,533	70,112.84	14,785	6,783.40	120,533	70,112.84
lamparosa	-	-	-	-	-	-	-	-	143,998	67,511.60	289,304	171,235.40	143,998	67,511.60	289,304	171,235.40
langosta	30,228.50	50,893.70	-	-	-	-	-	-	-	-	-	-	30,228.50	50,893.70	-	-
lebranche	-	-	22,330	14,426	-	-	-	-	26,114	17,693.12	45,272	34,224.14	26,114	17,693.12	67,602	48,650.14
lisa	234	224	138	120	328,729.87	251,631.75	88,356.50	59,978.45	65,320	27,236	484,290	326,651.25	394,283.87	279,090.75	572,784.50	386,749.70
lomo	-	-	-	-	-	-	322	212	-	-	-	-	-	-	322	212
lonja	-	-	-	-	-	-	5,974	4,762	-	-	-	-	-	-	5,974	4,762
macabi	-	-	-	-	-	-	-	-	-	-	1,142	734	-	-	1,142	734
maculra	-	-	-	-	-	-	-	-	586	146.50	1,550	387.50	586	146.50	1,550	387.50
machuelo	-	-	-	-	-	-	-	-	10,150	1,489	34	19	10,150	1,489	34	19
manamana	-	-	-	-	26,904	7,401	26,833	18,685	-	-	-	-	26,904	7,401	26,833	18,685
manati	-	-	-	-	110	82	58	35	-	-	-	-	110	82	58	35
meregal	200	185	-	-	-	-	-	-	-	-	-	-	200	185	-	-
mero	171,210	138,319.85	4,950	3,920	33,880.50	23,561.71	12,763	10,546.75	177,641	90,080	150,497	96,801	382,731.50	251,961.56	168,210	111,267.75
mojarra	-	-	-	-	-	-	-	-	80	32	-	-	80	32	-	-
mucuso	-	-	-	-	15,420	7,589	-	-	-	-	-	-	15,420	7,589	-	-
ojo gordo	48	55	-	-	-	-	-	-	3,020	1,460	2,600	1,040	3,068	1,515	2,600	1,040
ojon	275	150	-	-	-	-	-	-	-	-	-	-	275	150	-	-
paguara	-	-	-	-	-	-	685	205.50	637	309.25	-	-	637	309.25	685	205.50
palometa	-	-	1,300	900	1,487.50	804.25	17,422	10,751	-	-	-	-	1,487.50	804.25	18,722	11,651
pampano	-	-	-	-	7,822.50	2,952.35	2,961	920	9,169	4,582	8,934	5,554.50	16,991.50	7,534.35	11,895	6,474.50
pargo	274,361.75	288,486.90	5,010	4,469	116,276.95	87,216.34	1,526	1,526	280,627	160,664.13	224,505	143,971.16	671,265.70	536,367.37	231,041	149,966.16
pargo de piedra	-	-	-	-	-	-	-	-	330	206.25	-	-	330	206.25	-	-
parguete	80	80	-	-	-	-	-	-	-	-	-	-	80	80	-	-
petota	-	-	-	-	-	-	-	-	16,638	8,364	2,688	1,424	16,638	8,364	2,688	1,424
pez burro	-	-	-	-	-	-	-	-	1,749	1,092.51	57	41.87	1,749	1,092.51	57	41.87
pez espada	-	-	-	-	230	240	7,410	5,274.50	-	-	-	-	230	240	7,410	5,274.50
picua	7,675.25	7,669.05	-	-	217	157.31	-	-	64,635	27,574.75	204,754	116,498.30	72,527.25	35,401.11	204,754	116,498.30
plateada	-	-	-	-	10,650	5,270	-	-	-	-	-	-	10,650	5,270	-	-
rabi-rubio	120	145	-	-	-	-	-	-	3,940	1,871	1,100	770	4,060	2,016	1,100	770
raya	-	-	-	-	-	-	64	25.60	3,243	1,781.49	32,202	23,082.25	3,243	1,781.49	32,266	23,107.85
rey	-	-	-	-	16,025.75	9,802.95	2,050	1,191.50	-	-	-	-	16,025.75	9,802.95	2,050	1,191.50
robalo	-	-	-	-	4,055.50	2,800.20	1,026	727	2,635	1,561.87	59,055	36,659.50	6,690.50	4,362.07	60,081	37,386.50
roncador	151	75.50	-	-	4,995	2,612.37	-	-	15,900	5,803.05	2,428	1,312.45	21,046	8,490.92	2,428	1,312.45
rosco	-	-	-	-	202	141	-	-	-	-	-	-	202	141	-	-
rubio	954	833.50	-	-	-	-	-	-	-	-	-	-	954	833.50	-	-
sabalo	-	-	-	-	25	18	29	35	705	441.25	514	128.50	730	459.25	543	163.50
salmon	90	90	-	-	-	-	-	-	-	-	-	-	90	90	-	-
San Pedro	-	-	-	-	-	-	-	-	2,488	975.20	-	-	2,488	975.20	-	-
sardina	-	-	-	-	10,575	3,778	-	-	494,154 3/	50,946.35	-	-	504,729	54,724.35	-	-
sargo	-	-	-	-	787	144	-	-	-	-	-	-	787	144	-	-
sierra	-	-	-	-	-	-	-	-	14,586	13,783	1,110	950	14,586	13,783	1,110	950
sol	442	415.50	-	-	-	-	-	-	-	-	-	-	442	415.50	-	-
tahali	-	-	-	-	-	-	-	-	78,774	25,197.84	131,339	63,493.95	78,774	25,197.84	131,339	63,493.95
tiburon	-	-	-	-	130	107	8,924	6,949	131	32.75	2,758	1,968.50	261	139.75	11,682	8,917.50
tonquincha	-	-	-	-	-	-	-	-	32,502	13,599.92	13,065	5,946.50	32,502	13,599.92	13,065	5,946.50
tortuga	-	-	-	-	70	23	-	-	411	254.12	-	-	481	277.12	-	-
tumba	130	100	-	-	-	-	-	-	-	-	-	-	130	100	-	-
varios	659	335.90	-	-	-	-	-	-	-	-	-	-	659	335.90	-	-
viejo	-	-	-	-	9,731.75	4,809.36	-	-	-	-	-	-	9,731.75	4,809.36	-	-
zapatero	-	-	-	-	-	-	-	-	1,300	520	-	-	1,300	520	-	-
zorra	85	65	-	-	-	-	-	-	-	-	-	-	85	65	-	-
Totals	679,727.50	674,205.05	475,193	280,368	826,200.215	542,761.03	781,335.75	508,186.65	5,214,290	1,718,417.16	6,354,625	3,671,750.01	6,720,217.715	2,935,383.24	7,612,155.75	4,460,304.66

1/ 1 kilogram - 2.2 pounds

2/ 1 Bolivar - $0.30 (U.S.)

3/ Practically all canned.

4/ From Report of the Ministerio de Agriculture y Cria.

Table 5 - General Resume of Production and Value of Fresh and Salt-Fish in the Republic, During the First Six Months of 1943. 1/ (Total for All Zones Combined)

Variety	Fresh		Salt	
	Kilograms	Bolivares	Kilograms	Bolivares
Aguja	84	63	-	-
Anchoa	64,092	28,912	114,906	69,238
Arenque	879,000	95,750	-	-
Armadillo	1,964	1,238	-	-
Atun	3,148	1,594	370	259
Blanco	3,605	3,411	-	-
Blanquilla	3,591	5,110	300	330
Bocachico	5,370	3,376	16,047	11,393
Bonita	407	164	1,100	750
Burro	102	62	-	-
Burrito	16,930	6,948	-	-
Cabana	23,119	8,578	237,920	152,217
Cachicato	7,596	8,162	860	929
Cachorreta	2,044	1,027	19,964	10,521
Cagalona	8,768	4,123	3,661	1,298
Camaron	4,017	2,118	8	6
Canario	3,082	807	-	-
Carite	306,686	267,179	421,981	330,114
Carpeta	13,086	6,799	-	-
Carrachana	5,173	2,083	13,325	9,295
Cataco	60,700	27,810	249,619	150,927
Catalana	7,173	4,164	-	-
Catalufa	1,549	792	-	-
Cazon	133,477	62,252	371,544	246,415
Cojinua	15,398	8,339	40,542	25,124
Corocoro	165,421	75,313	483,835	246,214
Coti	3,679	1,866	-	-
Cuna	34,896	25,278	18,437	12,765
Cunaro	19,648	14,308	169,121	117,613
Curbina	173,175	88,957	1,111,987	778,926
Curbinata	2,952	1,043	-	-
Chicharro	21,321	11,263	76,991	40,342
Chucho	615	748	380	247
Doncella	849	513	276	138
Dorado	2,351	1,805	-	-
Guanapo	2,908	3,019	-	-
Guasa	1,481	929	-	-
Jurel	270,750	123,506	580,527	239,561
Jurelete	8,077	3,249	40,411	25,373
Lamparosa	144,149	69,283	187,405	107,240
Langosta	43,299	62,567	-	-
Lebranche	169,693	138,366	83,983	58,177
Lisa	207,474	133,040	663,395	492,090
Macabi	244	122	-	-
Macuira	3,938	1,494	936	234
Machuelo	780	735	-	-
Mazamana	26,878	16,065	118,041	76,750
Meregal	661	815	6,290	4,679
Mero	240,561	180,258	118,148	80,010
Mojarra	4,067	2,352	3,450	2,495
Ojo gordo	1,604	821	1,418	730
Ojon	195	261	-	-
Paguara	23	22	-	-
Palometa	4,369	2,941	-	-
Pampano	5,545	3,136	792	316
Pargo	294,406	253,142	131,493	91,870
Pargo piedra	5,017	2,707	-	-
Petota	7,155	3,641	6,861	3,616
Pez burro	1,566	903	300	182
Pez espada	814	570	1,556	992
Picua	42,966	28,127	74,374	44,260
Plateada	419	190	-	-
Rabi-rubio	8,396	7,672	-	-
Raya	8,061	4,192	23,681	15,093
Rey	1,163	611	-	-
Robalo	49,393	31,623	203,136	146,297
Roncador	68,985	36,080	31,648	17,245
Ronco	76	39	2,200	1,100
Sardina	166,594	21,325	-	-
Sargo	45	27	-	-
Sierra	2,647	2,174	1,530	1,225
Sol	793	545	-	-
Tahali	79,070	42,147	117,697	63,538
Tiburon	-	-	548	213
Tonquinche	88,868	41,745	97,731	57,795
Misc.	173,198	94,347	111,037	51,469
Total	4,131,403	2,086,749	5,961,860	3,787,489

1/ From data furnished by the Ministerio de Agricultura y Cria.

Further analysis of Tables 4 and 5 follows, in order to determine the most important species in the production of fresh and salt fish for each area. Since 1942 is the latest year for which complete statistics are available it is used throughout the following sections.

Thus, of 98 varieties listed for the entire country, 94 are sold fresh and 59 are used to prepare salt-fish. Varieties sold only as fresh-fish number 39. Four varieties are used exclusively as salt-fish and 55 are used for both salt and fresh-fish.

Table 6 - Utilization of Varieties of Fish for Salting and For Fresh-Fish - 1942
(Number of varieties)

Use	Central	Z O N E Western	E Eastern	All Zones Combined
Fresh	36	40	60	94
Salt	13	29	45	59
Fresh only	28	15	17	39
Salt only	5	4	2	4
Salt and Fresh	8	25	43	55
Number of varieties	41	44	62	98

To determine the most important varieties in each Zone for fresh-fish and for salt fish, the five varieties showing the greatest landings are selected.

Table 7 - Five Most Important Varieties of Fresh and Salt-Fish by Zones, 1942, (in Kilos: 2.2 pounds)

Variety	Central Zone		Western Zone		Eastern Zone		All Zones Combined	
	Fresh	Salt	Fresh	Salt	Fresh	Salt	Fresh	Salt
Pargo	274,361.75	5,010.00	116,276.95	-	200,627.00	-	671,265.70	-
Mero	171,210.00	-	-	-	177,641.00	-	382,731.50	-
Carite	90,897.50	300,457.00	-	69,835.50	926,243.00	938,344.00	1,061,520.50	1,308,636.50
Blanco	65,988.00	-	-	-	-	-	-	-
Corocoro	12,724.50	-	-	-	272,186.00	956,348.00	-	956,448.00
Jurel	-	105,950.00	50,542.42	-	262,133.00	687,128.00	313,954.42	804,544.00
Lebranche	-	22,330.00	-	-	-	-	-	-
Anchoa	-	18,700.00	-	-	-	-	-	-
Lisa	-	-	328,729.87	88,356.50	-	484,290.00	394,283.87	572,784.50
Canaro	-	-	52,273.72	-	-	-	-	-
Bocachico	-	-	44,399.25	93,386.50	-	-	-	-
Curbina	-	-	-	309,686.00	-	-	-	-
Cazon	-	-	-	107,331.00	-	482,214.00	-	589,605.25
Total	615,181.75	452,447.00	592,222.21	668,595.50	1,918,830.00	3,548,324.00	2,823,755.99	4,232,018.25

Having calculated the totals of the five most important salt and fresh fish varieties for each Zone and for all Zones combined it is now possible to calculate the contribution made by each selected group of varieties to the total production (Table 8).

Table 8 - Contribution of Five Most Important Varieties of Fresh and Salt Fish to Total Production, 1942, (in kilos: 2.2 pounds)

Item	Fresh Fish Z O N E Central	Western	Eastern	All Zones Combined
Total of 5 most important varieties	615,181.75	592,222.21	1,918,830.00	2,823,755.99
Total of all varieties	679,727.00	826,200.00	5,214,290.00	6,720,217.715
Percent	90	72	37	42
	Salt Fish			
Total of 5 most important varieties[1/]	452,447.00	668,595.60	3,548,324.00	4,232,018.25
Total of all varieties	476,195.00	781,335.75	6,354,625.00	7,612,155.75
Percent	95	85	56	56

1/Dry, cleaned, salt-fish weight.

As a final step, all figures have been converted to weight as landed fresh in the round state. To accomplish this, salt-fish totals are multiplied by four and added to fresh-fish totals. Table 9 shows the contributions, in percentages, made by each selected group of salt and fresh fish to the total production as landed.

Table 9 - Contribution of the Five Most Important Salt and Fresh Varieties to Total Landings of All Fish, As Landed in the Round, By Zones, 1942, (in kilos: 2.2 pounds)

Item	Z O N E			All Zones Combined
	Central	Western	Eastern	
Total Weight of all fish1/	2,584,507.50	3,951,543.00	30,632,790.00	37,168,841.00
Total of 5 most important fresh varieties	615,181.75	592,222.21	1,918,830.00	2,823,755.99
Percent	24	15	6	8
Total of 5 most important salt varieties1/	1,809,788.00	2,674,382.00	14,193,296.00	16,928,073.00
Percent	70	68	46	45
For canning2/	-	-	1,928,654.00	1,939,229.00
Percent	-	-	6	5

1/Weight as round, fresh-fish as landed. Salt-fish weight multiplied by 4.
2/Arenque and sardina.

FISHING CRAFT

Practically every craft used for fishing in Venezuela is constructed locally. Vessels of foreign origin have been introduced from time to time but are not in general use in actual fishing operations since they are of specialized types designed to operate rather complicated gear generally unsuited to Venezuelan conditions. When their use has proven uneconomic for fishing they are sold to be used for commercial freighting or as cannery tenders.

With the recent immigration of Old World fishermen to Venezuela, a number of motorized vessels of southern European types have been constructed in Venezuelan yards. Hull designs and construction details represent an absolutely novel development in Venezuelan boat building. None of these craft have remained in operation with the exception of the Nueva Esparta which is used by the Venezuelan Government as a patrol vessel for the pearling industry. Such vessels have been found to be practically unusable for Venezuelan fishing conditions and their design and construction not as good as that of craft built along traditional lines by Venezuelan builders.

During the past few years, with the development of canneries, interest has developed in the construction of fishing vessels patterned after North American types--principally small purse-seiner or shrimpdragger designs. As a result of this trend, several boats have been built or are being built and much interest has been expressed in this activity with a view toward replacing present fishing craft with more modern and more efficient types.

The traditional types of fishing boats now used in Venezuela are well built and suitably adapted for the particular type of activity in which they are engaged. Since the abundance of coastal species of fish is great there has been no need or desire to construct large boats for fishing. Large schooners, however, can be built and have been built for years for coastwise and Caribbean commerce. If larger and more modern types of fishing craft are needed they can be built in Venezuela.

All Venezuelan fishing boats are of wooden construction. Formerly, native woods were used for the ribs and keel, and the lumber for the planking was imported. Now, native woods of excellent type are being used for the planking also. Natural bend woods are used exclusively rather than steam-bent woods for ribs, stems and sterns. Fittings, bolts, nails, and other metal parts are imported. Labor is almost all hand work and many boat builders show a high degree of skill. Costs of construction are not high. A 50-foot wooden hull built in Porlamar, Isla Margarita, along the lines of a purse-seiner was reported to cost

about Bs 10,000 (3,000.00 U.S.) without the engine and certain fittings.

By far the majority of fishing craft are propelled by oars, paddles, or sails, depending on their use in the fisheries. Piraguas, used in beach-seining, are paddled. Tenders for nasas and some boats used for handlining are rowed or sailed, and trolling craft are sailed. Piraguas are the largest of the fishing craft--some may be as long as 40 feet. Few, if any of the boats used for fishing are decked and none have "accommodations." Almost all are hauled up on the beach more or less regularly and therefore do not require bottom sheathing. Larger vessels which cannot be hauled up must have the bottom sheathed with copper or bronze. All craft are usually well kept and painted at frequent intervals.

Considerable numbers of outboard motors are used in some areas--especially from Chacopata eastward. Many are used around Rio Caribe and Carupano.

Lacking more recent information, the following data on the number and distribution of fishing craft are taken from the Report of the Ministerio de Hacienda for 1936. These represent craft of from 1 to 5 gross tons registered in the Customs Houses and licensed for fishing. The figures do not include unregistered craft, or those of less than 1 gross ton:

Custom House	Number of Boats
Pampatar	404
Carupano	130
Puerto Sucre	147
Guanta	64
La Guaira	42
La Vela	42
Puerto Cabello	93
Las Piedras	143
Maracaibo	220
Total	1,285

Since the total number is doubtless much too small to represent current conditions, the United States Fishery Mission of 1942 revised it upwards and estimated that at least 3,000 craft of all types were in regular use for fishing during 1942. It is quite possible that this estimate, also, is low. Recent studies, made by the Servicio de Pesqueria will permit a much more accurate estimate when the data become available.

GEAR

The coastal nature of the present Venezuelan fishing industry is reflected by the types of gear used. Even though attempts have been made to introduce purse seines, lamparas, otter trawls, and line trawls, they have not been adopted. The traditional forms of Venezuelan fishing gear--haul seines (chinchorros and mandingas), fish pots (nasas), gill nets (filetes), cast nets (atarrayas) and hook-and-line (cordel y anzuelo)--have, until now, been able to supply all of the tocal demands for fishery products.

The chinchorro fishery reaches its highest development in the regions of the Gulf of Cariaco, Isla Coche, Isla Margarita, and Chacopata, but it is engaged in elsewhere to a limited extent. Many of the nets are very long and deep, and hundreds of men, women, and children are employed in operating them and caring for the catches made.

The gill net fishery is most prominent in and around Lake Maracaibo and around the shores of the Gulf of Venezuela, but that type of gear is also used in the Eastern Zone, particularly east of Chacopata.

Handlining and trolling are very important around Isla Margarita, Isla Coche, at Rio Caribe and to a lesser extent in the Gulf of Cariaco. These activities, however, are carried on to a greater or lesser degree along the entire coast.

In the Tacarigua and Unare Lagoons the only gear used is the atarraya. Such nets are

to be encountered, however, wherever fishermen are found, for they are extensively used to catch bait and to take fish for personal use.

Nasas are used rather widely from Puerto Cabello eastward, but they are not of primary importance in fish production.

Miscellaneous types of gear, such as shark line-trawls (palangres) and harpoons are used to a limited extent and chiefly in the eastern zone.

All netting used in the fisheries is hand-knit by the fishermen. Cotton twine and much smaller amounts of linen and hemp are imported to supply the demand. The hand-made nets are very well constructed and compare favorably with those made by modern machines. Almost all rope and cordage employed in fishing is made locally—often by the fishermen themselves from agave (coquiza), sisal, or from the bark of certain trees. Rope and cordage of excellent types also are made in considerable quantities and at reasonable prices by a rope factory at Barquisimeto.

Very little, if any imported cork is used for net floats. The fishermen employ several species of light woods (madera de corcha, etc.) to float their nets. Weights are made of stones, sheet lead, and in the Paraguana, of a special type of hard-baked clay.

Nets receive no preservative treatment except in the Maracaibo-Paraguana region where mangrove extract is used at regular intervals for tanning or barking. Handlines are also sometimes treated by rubbing them with mangrove bark. All nets, however, are dried in the sun and the average life of netting is not as long as if more care were taken to conserve it through the use of various preservatives or other measures.

No mechanized gear is used for handling nets, although many fishermen recognize that such devices would constitute a great advantage.

Imported twines, wire, hooks and other necessities can be procured in Venezuela but prices are very high. The Government of Venezuela is attempting to alleviate this situation and has succeeded in obtaining some of these items at reasonable prices for the fishermen. Large shark hooks of an excellent type are now being made on a small scale in Venezuela. They are considered superior to imported hooks since they do not straighten out when large sharks are caught.

It has been impossible, up to this time, to obtain concrete information on the total quantities of gear used in the three zones of the Republic. When data, now being compiled by the Servicio de Pesqueria, are made available, they will be valuable in determining the catches per unit of gear, and other indexes and measures of abundance and availability of the various species that support the commercial fisheries of Venezuela.

FISHERMEN

Venezuela is most fortunate in having a large coastal population of fishermen. This population and its forebears have fished for more than 400 years; and, as a result, men with excellent ability and experience are found. The fishermen of the Eastern Zone are perhaps the best—particularly those of Isla Margarita, Isla Coche, and the Gulf of Cariaco. Many skilled fishermen also are to be found in and around Lake Maracaibo and at other places. Most Venezuelan fishermen are industrious, intelligent, and cooperative, and many are, or would be, progressive if they had the opportunity. In terms of fishermen, almost any type of fishery development would be possible, particularly if labor-saving methods were introduced gradually. There is abundant evidence to indicate that if aid were extended to certain fishing techniques, particularly in the Gulf of Cariaco where fishermen have observed fishing demonstrations with modern purse-seines.

Lacking recent information on the number of fishermen employed in Venezuela, the statistics for 1936 are used. In that year the Ministerio de Hacienda reported that about 6,425 full-time fishermen were engaged in fishing on boats of over 1 ton gross measure. This total was regarded as very low by the United States Fishery Mission of 1942, which

estimated that there were at least 20,000 commercial fishermen engaged in the Venezuelan fisheries in 1942. This figure is also too low since it has been stated that 20 percent of Venezuela's population, about 750,000 persons, obtains its livelihood from fishing in the sea, in the rivers, and in the lakes.

FISHING GROUNDS

At present it may be said that the Venezuelan fisheries are coastal. Only at times do the fishermen go more than 10 to 15 miles offshore and then usually to visit one of the off-lying islands such as Tortuga, Los Testigos, or La Orchila. During the known runs of fish (tiempo de cosecha) migrant fishermen camp on these otherwise deserted islands and utilize them as bases of fishing operations and for salting and drying their catches. From time to time, under special conditions, as at present at Los Roques, more or less permanent colonies of fishermen are established. Occasionally, fishing vessels go offshore to handline for red-snapper and grouper, but this is by no means a regular occurrence. Probably the basic reason for the coastal nature of the fisheries is that this extent of activity has always been sufficient to supply all the fishery products needed for the available markets. With increased demands, the fisheries doubtless will expand to offshore regions and the fishermen will gradually develop customary offshore fishing techniques.

The accompanying map (Figure 1) shows the present fishing grounds in Venezuela, which are indicated by the stippled areas. There is no attempt made to denote quantitative fishing intensity, but the dots merely indicate sites of fishing activity. (The shaded areas are non-Venezuelan territory.)

Fish, in general, are fairly abundant throughout the year on the coast of Venezuela. However, the nature of the present fishing operations is such that very little is known of the seasonal occurrence of fish offshore. From a study of monthly production records and from interviews, as well as from field observations, it is quite apparent that fish are more available during certain months of the year than in others. The fishermen are well aware of this fact and they call the time of abundance "el tiempo de cosecha" (the harvest time). During these months their biggest catches are made and salt-fish production reaches its height. During the remaining months of the year fish are taken for local and home use and surpluses are salted for the market.

During the period of abundance, catches are composed, to a large extent, of migratory fish such as carite, anchoa, jurel, lebranche, lamparosa, cachorreta, cabana, curbina, sierra and chicharra. Outside of this period some of the above named species are taken but the bulk of catches consist of pargo, mero, corocoro, arenque, tahali, lisa, pez espada (sawfish), cazon, and other fish which are more or less resident in certain areas during the entire year. With the recent great increase in the demand for fresh-fish many non-migratory species such as pargo, mero, and tahali are also fished for during the time of abundance of the migratory species. Perhaps the best separation can be based on the fact that during the "harvest time" fish appear more frequently in large schools--at other times they are more or less scattered.

The observations of the two fishery missions to Venezuela--one in June 1942 and the other in September, October, and November, 1943--are interesting in this connection. During the 1942 study the survey party visited the Gulf of Cariaco during the height of the season of abundance. Numerous schools of fish were observed, myriads of birds were present, and fish-drying facilities were crowded to the utmost. Every available net, man and boat was occupied. During the second study in the Gulf of Cariaco, in October and November, 1943, most of the producing units were tied up; very few, if any, schools of large fish were seen; and, in general, there was a scarcity of fish in the markets. In November when the mission proceeded eastward, however, more and more schools of fish were observed, and fishermen reported that the expected runs were arriving from the eastward and passing further west day by day.

By synthesizing the various data available concerning seasonal occurrence, the following statements may be made:

Eastern Zone.--The big and compact schools of migratory fish are present from January

Figure 1

PRESENT FISHING AREAS
MAR CARIBE
VENEZUELA
PENINSULA DE LA GOAJIRA
ARUBA
CURAÇAO
BONAIRE
ISLAS DE AVES
LOS ROQUES
LA ORCHILA
BLANQUILLA
LOS HERMANOS
SAN VICENTE
BARBADOS
GRENADA
GOLFO DE VENEZUELA
PUNTA CARDON
PENINSULA DE PARAGUANA
LA VELA
CORO
LOS TESTIGOS
ISLA TORTUGA
LOS FRAILES
ISLA MARGARITA
PORLAMAR
TOBAGO
MARACAIBO
LAGO DE MARACAIBO
LA GUAIRA
PUERTO CABELLO
CARACAS
CABO CODERA
LAGUNA DE TACARIGUA
LAGUNA DE UNARE
GOLFO DE CARIACO
CUMANA
BARCELONA
CARUPANO
GOLFO DE PARIA
TRINIDAD
RIO SAN JUAN
DELTA DEL ORINOCO
RIO ORINOCO
WEST
72°
71°
70°
69°
68°
66°
65°
64°
63°
62°
61°
60°
14°
13°
12°
11°
10°
9°
8°
NORTH

to August. They first appear at Cape Malapasqua far to the eastward. Gradually they reach points to the westward along the coast. In succession, the schools are reported off Rio Caribe, Carupano, Esmeraldas, Chacopata, Isla Coche, Pampatar and then off Araya where they swing into the Gulf of Cariaco. These fish remain in the Gulf for some months feeding on arenque; and they are, in turn fished heavily by the fishermen in the Gulf. Toward the end of August, the schools disperse and move out. There is evidence to indicate that the various species do not all appear at one time--some species come into the Gulf before others. Also, resident populations of tahali, arenque, lisa, pargo, mero and other species may be found throughout the year.

Another run of migratory fish is reported to come in from the westward. This run swings in from offshore--possibly from the region of the offshore islands--and arrives at Morro Barcelona about January. It progresses on through the bays and straits from Guanta to the Gulf of Cariaco. A portion of this run seems to continue on to the south coast of Isla Margarita without entering the Gulf of Cariaco.

Lebranche leave the lagoons of Unare and Tacarigua during the rainy season when communicating channels are opened between these lagoons and the sea. The schools are reported to travel eastward along the coast and they also possibly enter the Gulf of Cariaco.

Pargo are reported to assemble in dense concentrations prior to spawning but little definite information as to the time or place of these occurrences is available.

Central Zone.--There is little information concerning the seasonal abundance of fish in this zone. Pargo are reported to concentrate during November and December close to shore. Scattered runs of carite and other species sometimes occur. Offshore, from La Orchila to Los Testigos, schools of sardines, tuna, bonita, and other migratory fish are reported during November to April.

Western Zone.--Information concerning seasonal occurrence in this zone is limited to observations of the shore fishermen on the west coast of the Paraguana peninsula and to the observations of fishermen in the Lago de Maracaibo on the west coast of Paraguana. Carite appear from August to October. Lebranche are caught from January to May. In late November, offshore in the Gulf of Venezuela, the members of the mission observed tremendous schools of carite and jurel moving eastward. Evidently the runs come in from off the Goajira peninsula, proceed to the entrance of Lake Maracaibo, then move eastward along the coast to the Golfito de Coro where they mill around for some time. From the Golfito they proceed northward along the Paraguana coast. In the Lago de Maracaibo big runs of curbina are usually present from January to April. In 1943, however, curbina were present during the entire year. Other species seem to remain in the lake the year around or enter only with the tides or at certain seasons.

While big runs of fish appear on the coast, in general, from January to August, there is reason to believe that resident populations and offshore concentrations would be sufficient to supply large quantities of fish during the remaining months of the year.

The following list outlines the seasonal occurrence of fish concentrations in different localities, and the known and suspected migration routes of fishes in Venezuela are indicated in Figure 2.

Location	Months of Abundance
Cape Malapasqua	December-January-February
Rio Caribe	January to July
Puerto Santo	May-July
Carupano	January to July
Guaca	June to August
Chacopata	January to August
Isla Coche	June-July-August
Porlamar	May to September
Pampatar	May to September

Figure 2

KNOWN AND SUSPECTED
FISH MIGRATION ROUTES
MAR CARIBE
VENEZUELA
PENINSULA DE LA GOAJIRA
ARUBA
CURAÇAO
BONAIRE
ISLAS DE LOS AVES
LOS ROQUES
LA ORCHILA
PENÍNSULA DE PARAGUANÁ
GOLFO DE VENEZUELA
PUNTA CARDON
LA VELA
CORO
MARACAIBO
LAGO DE MARACAIBO
PUERTO CABELLO
LA GUAIRA
CARACAS
CABO CODERA
LAGUNA DE TACARIGUA
LAGUNA DE UNARE
ISLA TORTUGA
BLANQUILLA
LOS HERMANOS
LOS TESTIGOS
LOS FRAILES
ISLA MARGARITA
PORLAMAR
PUNTA DE PIEDRAS
CARUPANO
CUMANA
BARCELONA
RIO SAN JUAN
GOLFO DE PARIA
TRINIDAD
TOBAGO
SAN VICENTE
GRENADA
BARBADOS
DELTA DEL ORINOCO
RIO ORINOCO
WEST
72°
71°
70°
69°
68°
67°
66°
65°
64°
63°
62°
61°
60°
NORTH
14°
13°
12°
11°
10°
9°
8°

Location	Months of Abundance
Gulf of Cariaco	January to August
La Lecheria	January to June
Unare Lagoon	April to July (lebranche)
Boca del Rio	January to August
Paraguana (west coast)	August to October (carite)
Paraguana (west coast)	January to May (lebranche)
Lake Maracaibo	January to April (curbine)

SALT

All salt used in the Venezuelan fisheries is manufactured by solar evaporation. The "salinas" range from the modern installation at Araya to other very rudimentary establishments at Piritu and at other places. In common with many other countries, salt is a Government monopoly in Venezuela and its collection and sale is controlled. All salt requirements for Venezuela for the year 1943 amounted to 23,000 tons. It is estimated that the production at Araya alone could be increased to 80,000 tons if need arises. With the Venezuelan Government's interest in furthering the development of local industry, special prices for salt are made to industrial users. Fishermen are able to buy, at Araya, a 50-kilo sack of salt for Bs 3.50. At other points, the prices are higher due to freight charges, profit by middlemen, and handling. The Ministerio de Agricultura y Cria is establishing salt depots throughout the fish-producing areas in order that salt may be supplied to the fishermen at reasonable prices.

The chemical analysis obtained from Venezuelan sources, of salt from Salina Araya, is as follows:

Item	Washed (purified) (percent)	Unwashed (not purified) (percent)
Insoluble matter	0.15	0.40
Water	0.74	1.42
Calcium sulphate ($Ca SO_4$)	0.53	0.80
Magnesium sulphate ($Mg SO_4$)	0.08	0.20
Magnesium chloride ($Mg Cl_2$)	0.10	0.43
Sodium chloride (Na Cl)	98.37	96.69
	99.97	99.94

Salt as now produced at the Araya works is only partially purified by washing. This is a temporary condition caused by mechanical failures in the purifying machinery. Steps are being taken to repair the machinery.

A sample of Araya salt was recently referred to the Technological Laboratory of the Fish and Wildlife Service at College Park, Maryland, for chemical analysis. The results of the analysis are as follows:

Item	Percent by Weight
Moisture	2.07
H_2O insoluble matter (mostly sand)	0.74
Calcium	0.62
Magnesium	0.27
Sulfate	1.57
Calcium sulfate ($Ca SO_4$)	2.10
Magnesium sulfate ($Mg SO_4$)	0.10
Magnesium chloride ($Mg Cl_2$)	0.98
Salt (Na Cl)	96.10

Results of this analysis indicate that the salt now being manufactured at Araya, as compared to that previously manufactured, is not as pure. As will be noted by comparison

of the analyses, the salt now contains a greater percentage of insoluble matter (sand), and more chemical impurities such as calcium sulphate and magnesium chloride.

CONTAINERS

Containers for packaging salt-fish products are an outstanding problem in Venezuela. At the present time, dry salt-fish is handled either in bulk or is sold in burlap sacks. Only the very best and most expensive grades are packed in wooden boxes. While lumber is available for manufacturing boxes for salt-fish, prices are high. A number of sawmills, particularly those at Maracaibo, can manufacture suitable packing boxes. Some of these mills already are producing boxes for Venezuelan products. The boxes are sold as shooks, and the purchaser nails and stays them. The most suitable wood for box-making at present prices is "jabillo." Lumber is available but present prices are high (Bs 200.00 per cubic meter for jabillo) due to transportation difficulties. Quotations of Bs 3.75 and Bs 6.90 for shooks for boxes holding 45.4 kilos and 98.8 kilos respectively, were obtained December 1943. To these quotations must be added nailing and freight charges. Capacity of the mills would be sufficient if the high prices could be paid. The only manufacturing center at this time is Maracaibo.

Water-tight barrels, suitable for packing brine salt-fish, are not made in Venezuela. Barrels are now manufactured by hand for holding water but these cannot be taken apart for fish packing since they are not constructed carefully enough to be waterproof when headed. Barrels of this type are, at present, made on a small scale at Cumana and at Maracaibo. Suitable wood for barrels to pack brine salt-fish is available at high prices (Bs 300-400 per cubic meter), the best type probably being "roble." It is possible that jabillo, which is slightly less expensive, could be used. However, no cooperage machinery is available in Venezuela and lumber costs are so high at present that it is probable that the staves, hoops, heads, and cooperage assembly machinery would have to be imported, at least for the time being.

LABOR

There is an ample supply of labor in Venezuela for fishery operations that do not require great skill or experience. The women employed by the canneries at Cumana and Porlamar for cleaning and packing arenque constitute a good example of the type of labor available. While their individual output is not great, the relatively low wage (about Bs 2.00 per day), is favorable. They appear capable of learning new techniques; and, if closely supervised, are quite satisfactory for the type of duties they perform. Workers at the isolated rancherias are always available since there are few activities other than fishing or processing fish.

It often has been said that there is a shortage of fishermen. This may be true with the present methods of fishing. A very little modernization would release ample labor for increased fishing and processing, since the present methods do not utilize manpower efficiently and in the interest of maximum quantity and quality of production.

The chief need in Venezuela is for machinists and foremen. While some good workmen may be secured, their experience does not usually encompass the more modern types of machinery. Supervisory and business management personnel can be engaged locally, but there must be a strong guiding administration as to policy and production standards.

Following are the latest available data on wages paid to various types of fishery labor:

Fishing Captain (Patron de Pesca).....	Bs. 8.00 per day
Sailors and workers in the fisheries...	Bs. 3.00 per day
Female cannery help.....	Bs. 0.25 per hour 6 a.m. 6 p.m.
Female cannery help.....	Bs. 0.37 per hour 6 p.m. to 6 a.m.

Usually the fishermen prefer to work on shares and not at a daily wage.

TRANSPORTATION

One of the chief difficulties in Venezuela facing extractive industries in general is transportation. At present the usual transport difficulties are aggravated due to war conditions. Fish and fishery products are moved entirely by boat or by truck. Usually catches are transported to the primary processing place in the boats of the fishermen, which are usually sail or row boats. Fish may be brought into the canneries by motor vessel—either by towing piraguas or by carrying the fish in the hold. Most often, fish destined for the fresh-fish market, are acquired by middlemen who operate launches or trucks. The launches are often equipped with iced hold space and the trucks carry insulated ice boxes.

Salt-fish usually is taken to the first buyer either in the boats of the fishermen, by boats of local head men (armadores), or in the boats of the buyer. These vessels are almost always sailing craft. To meet the demand for salt-fish in the interior, when it occurs, the salt-fish are loaded into and transported by trucks. Occasionally, as at El Hatillo, trucks obtain salt-fish direct from the fishermen.

A local steamship line operates along the coast of Venezuela and calls at all ports. In addition, many small, medium, and large goletas and tres punos are occupied in coastwise freighting.

There follows a tabulation of transportation tariffs for canned and salt-fish which was furnished to the mission by the Ministerio de Agricultura y Cria:

From Maracaibo to:	Bs per 100 kilos
Puerto Cabello	4.00
La Guaira	4.50
Guanta	5.50
Cumana	6.00
Porlamar or Carupano	6.50
Caripito	7.50
Tucupita	9.00
Ciudad Bolivar or San Felix	10.00

From Ciudad Bolivar to:	Bs per 100 kilos
Tucupita	2.00
Caripito	4.00
Carupano	5.00
Porlamar or Cumana	5.50
Guanta	6.00
La Guaira	8.00
Puerto Cabello	8.50
Maracaibo	9.00

It should be noted that the foregoing rates are for merchandise including salted or canned fish. Iced or fresh fish is transported in the private vessels of dealers. Coastal vessels of the country are not equipped to transport refrigerated fish.

Transportation by motor truck, on which much of the interior depends at present, is very expensive due to the scarcity of tires. "Camiones" (trucks) are able to reach many points under favorable conditions. Roads are very good in some places, but in other localities they can be used only during the dry season. Between some points the ocean beaches are used as roads.

Railroads are not used at present for fish transportation and it is doubtful that the present lines could be used to any great advantage.

As far as can be determined no regular shipping service is maintained between Venezuela and the remainder of the Caribbean area. Vessels now usually arrive on irregular

schedules and most often by direct routes to and from distant points without making intermediate stops. Fish shipments to other Caribbean countries must rely on local schooners or on fortuitous connections with other types of vessels.

An air freight service which reaches many interior points in Venezuela recently has been established and possibly may be extended to nearby foreign countries. No tariffs are available for fish shipments by this means, but it is possible that certain classes of fishery products could be carried.

PORTS

While Venezuela has many excellent harbors, comparatively few have been developed as ports equipped with docks, warehouses, and other facilities. At most points cargo must be lightered--sometimes to a small wharf and sometimes through the surf to the beach. This procedure adds markedly to the costs of handling and transportation.

First-class ports may be listed as Caripito, Puerto de la Cruz, La Guaira, Puerto Cabello, Las Piedras, and Maracaibo. Of these, Caripito, Puerto de la Cruz, and Las Piedras are used almost exclusively as oil ports. They are equipped with wharves, warehouses, and other facilities and might be used for shipping fish.

Second-class ports which would be usable for fish handling are Ciudad Bolivar, Cumana, Araya (salt port), Guanta, Turiamo, and Tucacas. Ports which could possibly be utilized in this connection, but which have few if any facilities would be Cristobal Colon, Guiria, Carupano, Pampatar, Porlamar, Juan Griego, Piritu, Carinero, and La Vela.

Many other places exist where small wharves could be installed or where fish could be lightered to larger vessels anchored in the roadstead. Some of these are Rio Caribe, Chacopata, Guaca, Puerto Santo, Coche (San Pedro), Boca del Rio, Chichirivichi, Punta Cardon, and Los Taques.

Ports of a suitable type are available in the large fish-producing centers. Thus, Cumana is regarded as the best port for the Eastern Zone, Puerto Cabello or La Guaira for the Central Zone, and Maracaibo for the Western Zone.

WAREHOUSING

Few facilities are to be found in Venezuela for warehousing fishery products. Salt-fish usually is stored in small buildings owned by the dealers or at the rancherias. Canned fish is stored in the canneries. No warehouses are designed or utilized exclusively for fishery products.

Few cold-storage plants of consequence are available for fish handling on the coast and little if any fish is stored in those that are available.

REFRIGERATION AND ICE-MAKING

Small quantities of ice are manufactured at many points along the coast, but the local demand for domestic purposes utilizes almost all of the production. Prices for ice are high, ranging from Bs 50 to 70 per ton (2,200 pounds) and the ice is not of first-class quality. Most of the ice plants are operated in conjunction with other activities such as local power plants, breweries, fish-canning plants, or ice-cream factories. There are now no plants operated exclusively for the fishing industry. Most of the plants are small; few, if any exceeding a capacity of 10 to 15 tons per day and the majority have a lower output.

While cold-storage facilities are available for fish storage at some points such as at Maracaibo, Porlamar and Caracas, they are not utilized to any great extent, since the local demand usually absorbs most of the daily supplies of fishery products.

There is, however, considerable refrigeration machinery now unused in the country which

could be installed at strategic points to serve the fisheries. The Ministerio de Agricultura y Cria is now engaged in surveying this machinery and making plans for its use in the fishing industry.

PROCESSING METHODS

About 60 varieties of fish are utilized regularly for salting. Although only 3 (carite, mero, and pargo) are preferred by consumers of fresh fish, 30 or more different varieties are to be found on the salt-fish market throughout all seasons of the year. Of the many species that are dry-salted, carite, corocoro, jurel, cazon, lisa, and curbina constitute the bulk of the poundage.

Salteries, as such, do not exist in Venezuela. Every fishing camp (rancheria) is a small, unit saltery. Some are equipped with concrete tanks for "butting" fish--others are not. Very few are equipped for shade drying. Many have enclosed areas of rocks or poles on which fish are dried in the sun. The lack of fresh water is a serious handicap in salt-fish production. In spite of these drawbacks, however, the fishing camp operators produce large quantities of salt-fish. The salting procedure is similar for all species, with the exception of ojo-gordo, lamparosa, cazon, and pez-espada--the principal difference being in the manner in which the fish are dressed. The heads of fish usually are not removed as in other salt-fish producing countries since the heads are used in soups, chowders, and in other esteemed native dishes.

Shortly after the fish are landed they are dressed. The procedure consists of laying the fish on a log, rock, or other convenient object and splitting the head. The split is continued along the backbone from the head to the tail so that the fish will lay out flat. The gills, viscera, and abdominal membrane are then removed. A horizontal gash is made under the backbone on the thick side in order to insure good brine penetration. The fish is scored longitudinally at one-half inch intervals, care being taken not to cut through the skin. The eyes of the fish are punctured to release the fluids contained and a cross-cut is made in the head just behind the eyes. The dressed fish are washed in sea water to remove blood, slime, and particles of viscera. Scales are not removed. Fish are salted individually. Salt is rubbed first into the cut along the backbone, then into the eyes, head, and other cuts. An additional amount is rubbed over the surface. Approximately one kilo of salt for each three kilos of fish is used in salting. The salted fish are piled, flesh side up, in old boxes, barrels, on rock platforms or on boards with salt sprinkled over each layer. After the fish are salt struck (about 24 hours) they are placed to dry in the sun. Average drying time is 3 to 4 days. The fish are often left out at night without cover. However, some rancheria operators, particularly in the Maracaibo area, stack the fish into piles which are then covered with burlap bags or canvas.

Flat-sided fish, such as ojo-gordo, chicharra, and lamparosa are dressed by removing the viscera and gills and scoring both sides diagonally at 1-inch intervals. Eyes are punctured to release the fluid. After washing in sea water, salt is rubbed into the belly cavity, eyes, and cuts, and the fish are then handled in the manner described above.

Large sharks, skates, rays, and sawfish are eviscerated, skinned, and the flesh cut into longitudinal pieces of about 1-inch in thickness. The dark flesh is not separated from the white. The flesh is scored and then washed to remove the blood and other extraneous matter. Salt is applied in the same manner and proportion as for other species of fish. The smaller sharks, skates, rays, and sawfish ordinarily are not skinned. The heads are removed and the remainder of the salting procedure is carried out as for other species of fish.

A special procedure for the dry-salting of sawfish was in use by a recently established enterprise at Maracaibo. Although interested primarily in liver oils, this company prepared a high-quality, salt-fish product which was finding a considerable local demand. The general procedure employed consisted of:

1. Cutting the carcass into longitudinal sections about one-half inch thick.
2. Scoring and salting.

3. Partial drying in the sun for one day.
4. Partial removal of moisture by pressing.
5. Further drying in the sun for 2 to 3 days.
6. Cutting the "hard-dried" flesh into rectangles of 3 by 4 inches.
7. Wrapping in heavily-waxed paper.

A "light-salted" fish product is also prepared. It is a regular practice among fresh-fish dealers, particularly at the municipal fish markets, to utilize unsold fish for this purpose. Considerable quantities of this type of wet-salted fish also are processed at the rancherias around Maracaibo and elsewhere. The fish are dressed and a light sprinkling of salt is distributed in the cuts and over the surfaces. Fish prepared in this way may be sold wet or may be partially dried in the sun. In any case, fish prepared by these methods will keep only for 3 or 4 days at the most. The product is considerably more moist than the dry-salted type and contains a much lower percentage of salt. The preparation and sale of fish of this type is gradually developing into a vicious circle; which, if continued will only act to the detriment of the quality of Venezuelan-produced salt-fish. This condition is particularly marked in the Maracaibo region. Here producers of salt-fish believe that they obtain a greater return if their fish is sold wet, for it is evident that wet fish weighs more than dry fish. One hundred kilos of fish as landed would result in about 40 kilos of wet salt-fish but only in about 25 kilos of dry salt-fish. Also, less salt and less labor is required in preparing wet salt-fish. On the other hand, however, the keeping quality of the wet salt-fish is so poor that it must be sold as soon as possible. The need for rapid disposal of the product places the producers under the control of the buyers who take advantage of them by cutting the prices. As the prices paid to the producers drop, the care taken in preparation of the salt-fish slackens and consequently the quality also declines. Since there is a large, steady demand for salt-fish in the Venezuelan Andean communities and since these markets do not demand fish of good quality, the type of fish prepared is becoming more inferior. It is quite probable that little can be done toward bettering the quality of fish sold in the interior markets since the consumers seem well satisfied with the present quality of the fish sold to them. For more discerning markets, however, and for consumers who can and will pay a greater price for well-prepared, dry salt-fish, the producers in the Maracaibo region can and should prepare better-conditioned salt-fish.

Very little, if any brine-salted fish now is prepared and consumed in Venezuela. Other Caribbean countries, however, do consume appreciable quantities of this type of product. Several species of fish such as herring (arenque), thread herring (machuelo), and chicharra (scad) are not utilized for salting in Venezuela. These species and others may be later utilized for brine salting. Also, species such as Spanish mackerel (carite) and bluefish (anchoa) now utilized only for dry salting could be brine-salted. The Caribbean markets normally import brine-salted fish such as alewives, salmon, herring and other species and these meet with excellent consumer acceptance. The Venezuelan species listed above, being quite similar, should also be well received.

MERCHANDISING

The salt-fish now produced in Venezuela is processed at many points in the individual rancherias along the coast. This fish is sold to buyers who often pick it up at the rancheria with their own boats or trucks. In other cases the fish is delivered to the buyer's place of business. Sometimes the head man (armador) of an area, for example at Coche, supplies or owns most of the nets and gear. He also advances salt, food, and other essentials to the fishermen in the area against their future production. By these means, most of the salt-fish produced in his particular region is controlled and sold by him. He may carry it direct to wholesalers or he may sell to a middleman who performs this service or who sells it outright to retailers. Some individuals own outright boats, gear, and rancherias and supply all necessities to the fishermen and workmen who receive a daily wage instead of a share of the proceeds of the production. Very little, if any, of the production is sold on long-range contracts and prices fluctuate greatly with the supply and the demand. Since the salt-fish produced in the majority of the rancherias does not keep for extended periods little warehousing or storage is engaged in. Even the largest buyers purchase sufficient stocks only for a week or so in advance. Thus, during periods of fish scarcity,

prices soar. During the harvest time when production is high, prices drop. This fluctuating price condition also tends to limit production, for producers will not process fish in excess of their probable sale.

There is a considerable spread between the prices paid to the fishermen or primary producer and the prices paid by the consumer. In one instance, carite bringing the fishermen about Bs 0.87 per kilo was sold at La Guaira retail at Bs 1.75 per kilo. This spread is taken up by the middleman's charges, transportation, merchandising costs, and profits.

Much salt-fish from the Maracaibo is transported into the Andes. It is landed at Maracaibo by boat, then transported by truck to such centers as Mototan, Muchuchies, and Trujillo. At these interior points weekly markets are held and people come from miles around to buy salt-fish and to sell agricultural and other products.

Locally produced salt-fish is now being sold in increasing quantities to the large haciendas in the eastern part of Venezuela. Previously the staple was canned California sardines and other inexpensive items of that type. Since the war such commodities have become practically unobtainable and are being replaced by salt-fish.

Small quantities of salt-fish have been exported to Curacao, Aruba and Trinidad, which are usually delivered to the wholesaler in the boats of the seller.

From January to September 1943, inclusive, 506,850 kilograms of salt-fish were exported to Trinidad, Curacao-Aruba, and Surinam. These exports were valued at a reported Bs 354,937 or about $0.10 per pound (U.S. currency). Exports of salt-fish to other American Republics were not recorded by the Customs.

As a matter of interest, exports of fresh-fish to the above-named destinations amounted to 470,500 kilograms valued at Bs 426,350 and 365,692 kilograms of canned fish valued at Bs 661,630.

COSTS AND PRICES

The calculation of costs and prices for raw and processed fish is difficult because the numerous factors which influence them are not constant for locality or time period. Little definite data can be secured. Producing and processing costs normally vary but little—in wartime, however, increased costs for fishing gear and other essentials make them rise. During periods of relative scarcity, prices for fish are high and during periods of abundance prices are much lower. Effects of the war have cut off much of Venezuela's formerly considerable imports of cheap canned fish, and the deficit is now being made up to some extent by Venezuelan canned and salt-fish. The increased demand for fresh-fish in Curacao and Aruba has led to the development of a considerable trade. Owners of motor launches and sailboats now call at many of the formerly isolated fish-producing communities and buy the fish as they are brought in by the fishermen. These fish are iced and taken to Curacao and Aruba for sale. Such activities have caused considerable increases in the price of fish—so much so that some Venezuelan communities often lack supplies of reasonably priced fish. Price data on Venezuelan fish are shown in Tables 10 and 11.

In October 1943 the following quotations for well-prepared, dry salt-fish were made at Isla Coche. Most dry salt-fish in Venezuela is sold by the arroba (11.5 kilos) or by the quintal (46 kilos):

Variety	Bs per arroba	Dollars per pound
Bagre, Quinche....	5.00	0.059
Machuelo.....	5.00	0.059
Cazon.....	5.00 to 6.00	0.059 to 0.071
Raya.....	8.00	0.095
Lebranche.....	10.00	0.119
Lisa.....	10.00	0.119
Carite.....	10.00	0.119
Jurelete.....	10.00	0.119
Jurel Grande.....	7.00	0.083
Corocoro.....	6.00	0.071

It was the experience of the mission that the prices listed above represent rather true averages. It must, however, be pointed out that these prices fluctuate considerably from place to place, from season to season, and because of the factors of market supply and demand. Thus it was brought to the attention of the mission repeatedly, that during the periods of abundance salt-fish could be purchased at prices considerably lower than those prevailing at other times. Also, it was stated that firm long-term contracts would lower prices.

As listed above, the prices include raw material, labor, salt, and processing. It is almost impossible to derive a true figure of cost of fish as landed since practically no fisherman keeps cost records. Prices of fresh-fish listed in Tables 10 and 11 do not represent true conditions either, for it can be seen that almost all varieties of salt-fish sell for less, pound for pound, than fresh-fish of the same kind. Another factor that causes difficulty in computing costs and prices is that the average fisherman does not include the cost or value of his own labor or that of his family in cleaning and processing the fish.

Fishermen in Venezuela usually take several factors into consideration in fixing their prices, but the personal equation often enters business dealings and may cause great variation in final quotations. These factors may be listed as: costs of upkeep of fishing gear and boat; cost of salt, food for his family, and clothing for his family; condition of the market; keeping quality of his fish; his indebtedness to middlemen or others; the distance from consuming markets; and on many other factors as well.

With the present facilities and methods used for production and processing at the rancherias it is very doubtful that any species of fish salted and dried could be obtained for less than Bs 4 per arroba (about $0.0474 per pound). This seems to be about the lowest price to which fishermen will agree under present prices for salt and replacements for fishing gear.

Table 10 - Approximate Average Prices Paid to the Primary Producer for Certain Varieties of Fish - 1942

Variety	Fresh		Salt	
	Bs per kilo	Dollars per pound (U.S.)	Bs 2/ per kilo 1/	Dollars per pound (U.S.)
Pargo	0.80	0.109	0.65	0.089
Mero	0.66	0.090	0.66	0.090
Carite	0.57	0.078	0.68	0.093
Blanco	0.90	0.124	-	-
Corocoro	0.44	0.060	0.49	0.067
Jurel	0.35	0.048	0.49	0.067
Lebranche	0.68	0.093	0.72	0.098
Anchoa	0.43	0.059	0.54	0.074
Lisa	0.71	0.097	0.68	0.093
Cunaro	0.55	0.075	0.69	0.094
Bocachico	0.52	0.071	0.57	0.078
Curbina	0.40	0.054	0.61	0.083
Cazon	0.33	0.045	0.49	0.067

1/ 1 kilogram: 2.2 pounds.
2/ 1 Bolivar: $0.30 U.S.

LOCAL REQUIREMENTS

Fish requirements for Venezuela can be set at approximately 100 million pounds annually. This figure is based on raw weight of fish as landed. This total, however, by no means represents a saturation of the market since the people of Venezuela could consume considerably more fishery products than at present.

The local consumption of fish has increased markedly during the past 2 years which

may be attributed almost entirely to war conditions. Imports of fishery products (normally about 8,000,000 pounds per year) have practically ceased. In addition, imports of inexpensive grades of canned meats and other protein foods have dwindled. The demands for local meats and fish for export to nearby countries also has caused a considerable increase in fish production for local sale.

Table 11 - Approximate Average Prices Paid to Primary Producers for Salt-Fish Entering Cumana During April, May, and June 1943

	April		May		June	
Variety	Bs per kilo	Dollars per pound	Bs per kilo	Dollars per pound	Bs per kilo	Dollars per pound
Corocoro	0.52	0.071	0.52	0.071	0.52	0.071
Cunaro	0.70	0.095	0.70	0.095	0.70	0.095
Lisa	0.70	0.095	0.70	0.095	0.70	0.095
Cabana	0.61	0.083	0.61	0.083	0.61	0.083
Picua	0.61	0.083	0.61	0.083	0.61	0.083
Lamparosa	0.61	0.083	0.61	0.083	0.61	0.083
Jurel	0.50	0.068	0.50	0.068	0.50	0.068
Cazon	0.61	0.083	0.61	0.083	0.61	0.083
Cataco	0.61	0.083	0.61	0.083	0.61	0.083
Anchoa	0.61	0.083	0.61	0.083	0.61	0.083
Carite	0.70	0.095	0.70	0.095	0.70	0.095
Jurelete	0.70	0.095	-	-	-	-
Tahali	0.52	0.071	0.52	0.071	0.52	0.071
Chicharra	0.52	0.071	0.52	0.071	-	-
Cuna	0.70	0.095	0.70	0.095	0.70	0.095
Petota	0.52	0.071	-	-	0.52	0.071
Bagre	0.52	0.071	0.52	0.071	0.52	0.071
Robalo	0.61	0.083	0.61	0.083	0.61	0.083
Curbinata	0.52	0.071	-	-	-	-
Lebranche	0.70	0.095	0.70	0.095	0.70	0.095
Raya	-	-	0.70	0.095	0.70	0.095
Cojinoa	-	-	-	-	0.61	0.083

Assuming that the population of Venezuela is about 4,000,000 persons, 100,000,000 pounds of fish as landed would result in a per capita availability of 25 pounds per year. It should be stated, however, that the per capita consumption is much in excess of this quantity on the coast and much less inland.

Taking all of the foregoing factors into consideration, it is the opinion of the mission that only the production in excess of 100 million pounds annually can be regarded as a true exportable surplus.

QUALITY OF PRODUCTS

Salt-fish products have been a mainstay in the diet of Caribbean peoples for centuries. The Caribbean Fishery Mission (1943) stated that normal imports prior to the war totaled 152,000,000 pounds. At the present average retail price of $0.15 per pound, this poundage is valued at $22,800,000 to the consumer. Converted to equivalents in whole fresh-fish and adding the normal catch of 161,100,000 pounds of the Caribbean countries, a total of 771,100,000 pounds of fish is consumed annually. The high consumption of salt-fish is due in part to its cheapness when compared to other animal protein foods. Pound for pound, dry salted fish furnishes from two to three times the amount of protein as do other types of food such as beef and poultry. Therefore, peoples of the low-income groups will continue to buy large quantities of salt-fish if it can be procured at reasonable prices.

War-caused demands for salted fish and other dislocations have complicated conditions to such an extent that there are indications that the traditional producers will not be able to supply even their normal markets. New fish-producing areas must therefore be found

and developed and better salting methods devised. As pointed out elsewhere in this report, Venezuela potentially can produce 75,000,000 pounds of salt-fish in excess of local requirements. This is approximately one-half of the total salt-fish requirements of all of the other Caribbean countries.

The kind of salt-fish products generally consumed in the Caribbean area can best be illustrated by citing a portion of the import figures for Puerto Rico, the largest Caribbean salt-fish importer.

By species, the imports of salted, pickled or cured fish by Puerto Rico during 1943, as reported by the General Supplies Administration were as follows:

Species	Pounds
Codfish	17,142,227
Herring	363,500
Salmon	1,677,436
Pollock	192,550
Haddock	17,410
Hake	52,316
Mackerel	1,112,749
Total	20,558,188

Dry-salted codfish (bacalao) constitutes the bulk of the imports. Canada, Newfoundland, and the United Kingdom supply most of the salt-fish consumed in the Caribbean countries. It is usually shipped in 224-, 400-, 448-, or 560-pound casks, net weight. Fish with a moisture content of 43 percent or less is generally preferred, since it keeps better than wetter fish. Cod, pollock, hake, and haddock are neither boned nor skinned. The color varies from light yellow through deep orange. Although fish heads are highly esteemed by Caribbean consumers, dry-salted fish are almost always received without the head. The moisture content and color are the chief criteria in judging quality. Previous mention was made of "reddening" of fish. Customs officials look for this condition when judging quality and will not allow the entry of fish displaying a pronounced red color. Reddening sometimes does occur, however, after the fish are on the market and fish displaying the color are often sold, but consumers usually consider this condition to be a first indication of decomposition.

Although the varieties of fish produced in Venezuela are not the same as those now imported into Caribbean markets, it is believed that there would be no consumer prejudice to Venezuelan dry-salted fish. If prices for the different species were maintained at the same level consumers would probably enjoy the wider choice of food products.

The mission examined many samples of fish for quality (Table 12) from the standpoint of possible increased consumption in Venezuela and for export markets. The samples were from 3 to 10 weeks old at the time of examination. Many of the samples exhibited red discoloration but there was some indication that fish of certain species do not discolor as quickly as others. Several factors, among which are differences in composition of the fish flesh, purity (bacterial) of the salt, and differences in moisture content between samples would influence this condition. It was also noted that the curbina and bagre samples were discolored more than others. The flesh of both fishes is soft and "gelatinous" and this tends to support the theory that the composition of the flesh influences the degree of reddening.

Fish prepared experimentally were included in the samples examined. These were roncador, robalo, pargo, and barbudo which were shade-dried for 1 week. After a 10-week storage period the robalo and barbudo displayed a red discoloration, whereas the roncador and pargo did not. The discoloration in the experimental samples was not as pronounced as in the commercial product and the flesh was considerably lighter in color. The only major differences in the preparation of the experimental samples were that: (1) more salt was used (30 percent by weight), (2) the fish were "butted" instead of "kenched", and (3) they were shade-dried for a period of 1 week. The experimental samples were more thoroughly dried

than the others. It is possible that the organisms responsible for reddening may require direct sunlight for maximum pigment production thus causing a more rapid discoloration of fish dried in the sun.

Although "red" fish are not dangerous to the health, their appearance is not pleasing to the eye. Also the "off" odors produced by fish in this condition are unpleasant and unappetizing. Officials regulating food supplies in countries that import large quantities of salt-fish prohibit fish from entering if a pronounced red color is evident. This fact alone should encourage salt-fish producers to prepare a product free of discoloration, or next best, to prepare a product in which the appearance of such discoloration is markedly delayed.

Table 12 - Results of Examinations of Venezuelan Dry Salt-Fish

Samples	No. of Samples Examined	Kind of 1/ Salt Used	Place Prepared	Date Prepared	Date Examined	Appear-2/ ance of Fish	Remarks
Carite	4	Unknown	Unknown	Latter part Oct.	1-1-44	+ ; 0	Well liked in Venezuela because of "rich" flavor.
Lebranche	2	Araya	El Hatillo	10-23-43	1-3-44	+	Would be acceptable if not red.
Lisa	4	Unknown	Unknown	Latter part Oct.	1-1-44	+	Would be acceptable if not red.
Roncador	2	Araya	Cumana	10-16-43	1-1-44	-	Shade-dried for one week; prepared Experimentally.
Curbina	5	Coche	Lake Mara-caibo	Latter part Oct	12-2-43	+ +	Examined at Maracaibo Public Market; dried for 3 days; moisture content high.
Robalo	1	Araya	Cumana	10-16-43	1-1-44	+	Shade-dried one week; prepared experimentally.
Corocoro	4	Unknown	Unknown	Latter part Oct.	1-3-44	-	- - - - - - - - - - - - - - - - - -
Cuna	3	Unknown	Unknown	Latter part Oct.	1-3-44	-	- - - - - - - - - - - - - - - - - -
Tahali	4	Unknown	Unknown	Latter part Oct.	1-3-44	+	Would be acceptable if not red.
Pampano	4	Unknown	Unknown	Latter part Oct.	1-3-44	+	Would be acceptable if not red.
Lamparosa	4	Unknown	Unknown	Latter part Oct.	1-3-44	+	- - - - - - - - - - - - - - - - - -
Barbudo	1	Araya	Cumana	10-14-43	1-3-44	+	Would be acceptable if not red; shade-dried one week.
Pargo	1	Araya	Cumana	10-14-43	1-1-44	-	Shade-dried one week; prepared experimentally.
Chicharra	2	Coche	Cumana	10-16-43	1-1-44	+	Fish not split; scored diagonally on scale side; acceptable if not red.
Ojo-Gordo	1	Araya	Cumana	10-14-43	1-1-44	-	- - - - - - - - - - - - - - - - - -
Roncador	1	Coche	Coche	10-18-43	1-1-44	+	Moldy; would be acceptable if not red.
Mojarra	1	Coche	Coche	10-18-43	1-1-44	+ ; 0	Definitely decomposed; not edible.
Bagre	6	Unknown	Unknown	Latter part Oct.	1-1-44	+ +	Reddening very pronounced; acceptable if not red.
Picua	4	Unknown	Unknown	Latter part Oct.	1-1-44	+	Would be acceptable if not red.
Anchoa	1	Unknown	Unknown	Latter part Oct.	1-1-44	+	Would be acceptable if not red.
Parguito	4	Coche	Coche	10-18-43	1-1-44	+ ; 0	Definitely decomposed; not edible.
Baya	1	Coche	Coche	10-16-43	1-1-44	-	- - - - - - - - - - - - - - - - - -
Pez Espada	1	Araya	Punta Cardon	11-25-43	1-1-44	-	Could be sold as a high-grade boneless product.

1/ All salts are solar-evaporated; name indicates salt works from which salt was procured.
2/ +: red discoloration; - : No discoloration, fish acceptable for consumption in other Caribbean countries; 0 : too highly oxidized or of appearance that would not be acceptable in Caribbean countries.

Salt-fish products prepared according to the methods described, with the exception of the "light-salted" product and sawfish prepared by the special method at Maracaibo, have a normal keeping period of from 3 to 6 weeks. The fish "redden" after that period of time and cannot readily be sold. Dry-salted fish now are usually consumed before reddening occurs and consequently little of the red discoloration normally is seen in Venezuelan cured fish. It is the opinion of the mission that if this condition could be remedied, more fish would be caught and prepared by the fishermen during seasons of abundance and consequently larger quantities would be available for local consumption and for export. Salt-fish dealers will handle only quantities that can be marketed rapidly and fishermen are therefore often idle when fish are most abundant. An approach to the problem of prolonging the keeping quality by controlling reddening has already been made and is discussed more fully in later sections of this report.

Attempts have been made by local producers to brine-salt herring (arenque) but this product has not found a ready market because of its poor keeping quality. Evidence was obtained that in some instances the fish were stale before packing and that watertight containers were not used. Experimental packs revealed (Table 13) that the principal reason for spoilage was the reddening of the brine and fish with subsequent "souring". Tests indicated that fish prepared experimentally kept well for a storage period of one month.

Apart from the above-mentioned difficulties there are no outstanding problems in regard to quality. The condition of salt-fish as prepared in Venezuela, before reddening occurs, is good enough to enable the product to enter practically all Caribbean markets; and, in some cases, markets outside of the Caribbean area as well. A very little more care in cleaning, salting, and drying and closer attention to packaging, grading, and marketing will insure steady market demands provided reddening can be overcome.

Table 13 - Quality of Brine Salt-Fish Prepared by the Mission

Species	Date Prepared (1943)	Place Prepared	Date Examined	Appearance of Brine	Odor of Brine	Percent Saturation of Brine	Appearance of Fish Flesh	Remarks
Machuelo	10/31	Isla Coche	12/22/43	light red	musty; sl. sour	100	sl.pink	Age of fish before salting not known (est. 8 hrs.) off odor near back bone.
Lebranche	10/23	El Hatillo	1/3/44	orange	musty; sl. sour	100	orange-red	Fish fresh (2 hrs. old); heads removed immediately after catching.
Arenque	10/26	Cumana	1/3/44	orange	musty; sl. sour	100	sl.pink	Fish in top layer of barrel red; under surface pink; fish about 12-18 hrs. old; heads and entrails removed.
Curbina	11/30	Maracaibo	1/3/44	light orange	very slight odor of decomp.	100	light orange	Fish approximately 4 hours old.

PART II

POTENTIAL PRODUCTIVE CAPACITY OF THE VENEZUELAN FISHERIES AND ITS ACHIEVEMENT

There is no doubt that the fishery resources of Venezuela will support an increased production without incurring immediate danger of depletion. Just how much added fishing intensity can be supported is, of course, unknown at this time. The following sections of this report deal with the various factors that influence increases in the production of salt-fish.

SECTION A

USING PRESENT FACILITIES AND METHODS AND SUPPLYING ONLY NECESSITIES FOR MAINTENANCE AND ORGANIZATION

PRODUCTION

Assuming that the present requirements for fishery products in Venezuela, expressed in round fish as landed, is 100 million pounds, it is calculated that, with increased fishing activity the catch can be doubled to yield a total of 200 million pounds. The estimate of 100 million pounds additional production has been derived from consideration and analysis of information from all possible sources. The primary basis, of course, was interviews with fishermen which provided data on the comparative abundance of the various species, the extent of use of each, and the possible output of the individual rancherias given increased firm markets. Catch statistics, furnished by Ministerio de Agricultura y Cria provided a valuable supplement to field interviews and they have been used extensively in the following sections of the report. Finally, knowledge of the productivity of the various types of gear in use, the characteristics of the species available for capture, and the methods of processing served to intensify the accuracy of the estimate. The increase of 100 million pounds of round fish as landed would be equivalent to about 25 million pounds of salt-fish.

Of this quantity about 15 million pounds could be procured in the Eastern Zone, chiefly at the Unare and Tacarigua Lagoons, Gulf of Cariaco, Isla Margarita, Isla Coche, and Chacopata. Considerable quantities could also be expected from other fishing centers in the same zone.

At least 10 million pounds could be secured from the Maracaibo-Goajira-Paraguana region, chiefly from around Maracaibo and Isla Toas.

These estimates are all based on a 12-month production after the necessary organization for purchasing and collection has been established.

CONVERSION OF FISHING GEAR AND CRAFT

The production operations described in this section do not include the conversion of fishing gear or craft. It is anticipated that fishing would continue along traditional lines with some additions in manpower, boats, and gear. The increased demand for fishery products would stimulate interest and actual development. To take full advantage of the potentialities, fishing supplies and the necessary materials must be made available to the fishermen at reasonable prices. The acquisition and distribution of these supplies can best be handled by companies who intend to purchase salt-fish for export.

DEVELOPMENT OF UNUSED OR UNDERUTILIZED SPECIES

The calculated increases in production will result, to a large extent, from the exploitation of species now not fished for, or from those species which are now caught in only small quantities due to the limitations imposed by present markets. Besides the yield obtainable from unutilized fishes, an enlarged production of species which are now caught in quantity for local markets could contribute to the development of an exportable surplus of fishery products.

Eastern Zone

Species which could contribute considerably greater quantities with present fishing methods are listed in Table 14. The 21 varieties listed made up 4,981,357 kilos out of a total production of 6,354,625 kilos of salt-fish in 1942. It is estimated that the catch of these varieties can be increased to about 11.700,000 kilos, a gain of 6,718,643 kilos (about 14,781,000 pounds).

Table 14 - Estimated Potential Production of Salt-Fish in the Eastern Zone of Venezuela

Variety	1942 Production	Estimated Potential Production
	Kilos	Kilos
Anchoa (bluefish)	260,715	500,000
Arenque (herring)	-	2,000,000 1/
Bagre (catfish)	50,453	500,000
Cabana (false albacore)	225,310	500,000
Cachorreta (mackerel)	11,856	100,000
Carite (kingfish) 2/	938,344	1,000,000
Carrachana (bonito?)	121,335	200,000
Cazon (small shark)	482,214	150,000
Corocoro (grunt)	956,348	1,500,000
Chicharro (scad)	177,678	500,000
Jurel (jack)	687,128	750,000
Lamparosa (moonfish)	289,304	500,000
Lebranche (mullet)	45,272	100,000
Lisa (mullet)	484,290	750,000
Machuelo (thread herring)	34	1,000,000
Pampano (pompano)	8,934	50,000
Picua (barracuda)	204,754	250,000
Raya (ray)	32,202	50,000
Roncador (grunt)	2,428	50,000
Zapatero (leather jack)	-	150,000
Tiburon (shark)	2,758	500,000
Total	4,981,357	11,700,000

1/All or majority salted in brine.
2/Most "carite" in this zone seem to be kingfish rather than Spanish mackerel.

Anchoa (bluefish) taken in Venezuela are probably of the same genus, Pomotomus, as those bluefish taken off the Atlantic Coast of North America, and they may possibly be the same species, saltatrix. Anchoa are well-liked by Venezuelans, particularly as dry salt-fish. The flesh is quite dark and very oily. When salted the flesh quickly turns dark brown and assumes an oxidized fish-oil odor. Salted anchoa does not store well since it turns rusty and rancid within a relatively short time. In the opinion of the mission, anchoa as now prepared would not be suitable for export. Most anchoa is now caught by trolling, by live-bait fishing methods, "guapeando", and by chinchorros and filetes. Those seen in the fishing camps in Venezuela were magnificent fish of large size. The small individuals are called "anchobetas." At Guaca, on the mainland just southeast of Isla Coche the months of greatest abundance are June, July, and August. At Puerto Santo, further to the eastward on the mainland the best season is May, June, and July. Evidently the schools travel in a westerly direction from the region of Trinidad and Tobago. Their appearance is characteristic of a pelagic species which is influenced by various oceanographic conditions.

Arenque are now taken only for canning and to a much lesser extent for bait. This species, averaging about 7 inches in length, belongs to the herring family and it is similar in shape to the North Atlantic herring. The flesh is quite similar to the northern herring, being quite oily. It assumes an off-white color when processed. The bones are quite numerous but small and soft. The center of distribution is in the Gulf of Cariaco and schools also are reported to occur along the coast to the eastward during certain seasons. Several schools were seen at Puerto Santo in November. Arenque are reported to be abundant in the Gulf of Cariaco throughout the year, but present fishing methods are not always successful in catching them. The best season seems to extend from January to August or September. The catch reported in 1942 was 1,434,500 kilos and practically all of the yield was canned. Considerable increases in the catch can be made with present gear and methods.

Arenque are best canned but should make a good brine-salted product. It is doubtful if dry-salting would produce a good product but it should be tried--particularly as a hard-dried, hard-salted, low-cost item handled in bulk. Arenque are now caught almost exclusively by chinchorros and mandingas but they could be taken with ease in ring nets, lamparas, and purse-seines.

Bagre or quinche are now taken only in very small quantities because the present markets will not absorb a large yield. It is probable that more than one species is included under this common name, but all seem to belong to a family of marine catfishes. Some individuals seem to be identical, or at least similar, to the gafftopsail catfish of North American waters. The size averages about 8 inches and the flesh is dark, rich, and oily. Quinche are very numerous at points around Isla Margarita, in the Gulf of Cariaco, and elsewhere, where they seem to be abundant during the entire year. Very large quantities could be secured with present gear if a demand existed. These fish would be suitable only as a low-priced, bulk dry-salted item.

Cabana are caught in fair quantities in the Gulf of Cariaco. Although no fresh specimens were observed, it is the opinion of the mission that this fish is the false albacore (Gymnosarda alleterata). It is a freely migratory species of the mackerel-like family of fishes which seems to enter the Gulf of Cariaco regularly in January, February, and March. It is understood that a considerable quantity is canned and marketed as "tuna". Dry-salt cabana, while well-liked in Venezuela for its high content of oil, would not be a suitable product for export since the color of the flesh is too dark and the odor, caused by oxidized oil, is usually too strong. Chinchorros and mandingas now catch practically all of the cabana taken in Venezuela. Probably nets of the purse-seine type would also be successful in capturing these fish. There is no doubt that catches can be increased considerably with present methods and gear.

Cachorreta are not taken in great numbers since the only market is to supply the canneries and the demand from that source is small. No fresh specimens were observed, but evidence indicates that the Venezuelan cachorreta is a close relative of the common mackerel of the Atlantic Coast. The average size seems to be about 12 to 14 inches. Large schools of cachorreta are found in the Gulf of Cariaco from January to June or July, and it is also found to a lesser extent in other areas during this same period. The fish are definitely migratory and do not occur throughout the year. While the flesh is delicate, oily, and well-flavored, cachorreta are not esteemed by the fishermen because they do not keep well. Some are caught for canning and a small quantity for salting, but catches could be increased greatly by present methods. Cachorreta probably are best as a canned fish, salmon style, but they should be excellent brine-salted. The quality of the flesh in dry-salted form is questionable. The bulk of the catches are now made incidentally in making hauls for arenque, jurel and other species.

Carite, in 1942, headed the list of varieties both for salt-fish and fresh-fish. While the common name, carite, is usually taken to denote the Spanish mackerel, it is without doubt often used as the name for kingfish as well. Carite, either salted or fresh, are esteemed by Venezuelans. The flesh is white when cooked, it is flaky,, and it has a good flavor. While carite does not contain as much oil as other species such as anchoa, jurel, and cabana, it turns yellow through oxidation after only a fairly short storage time. Its appearance and flavor, however, are such that it would be favorably received on Caribbean markets. Carite are caught quite universally in the Eastern Zone with particularly large takes around Isla Margarita, Isla Coche and in the Gulf of Cariaco. The chief method of capture is by trolling, but live-bait fishing, "guapeando", and haul-seining also contributes considerably to the catch. The periods of abundance are irregular as might be expected of this type of fish, but, in general, the greatest catches are made in the months from January to August or September. The catch of carite doubtless can be increased considerably with present gear and methods. Some carite is canned but it is usually considered best as a fresh-fish. Brine-salting would probably result in an excellent product and experiments conducted elsewhere have shown that smoked carite is very good.

Comparatively little is known of the carrachana, but from samples of dried specimens observed by members of the mission it is evident that it is a member of the mackerel family--possibly a bonito. The flesh is very dark, almost black, very bloody when fresh, and oily. As a salted product it is doubtful if it could be sold outside of Venezuela. The greatest catches seem to be made around Pampatar, and Isla Margarita, but this species is also taken at other places as well. The times of abundance are similar to and methods of capture are almost identical with those of the carite although it is by no means as abundant. Possibly brine-salting of this fish would produce an item which could be assured of an export market.

Cazon is the generic name applied to many kinds of small sharks and dogfish which occur rather widely in the entire zone and are taken more or less throughout the year. The flesh of cazon, either fresh or salted, is well-liked by coastal Venezuelans and a great quantity is consumed. When dried the flesh is inclined to be a little tough and fibrous, but that characteristic is more than compensated by the light color and lack of oxidized oil odor and flavor. The salted and dried meat is more resistant to reddening and decomposition by molds than most Venezuelan salt-fish products. When carefully prepared, its appearance is much like that of imported salt cod, and it usually carries no suggestion of "shark" odor or flavor. While shark meat cannot be sold as such in some West Indian communities, it is highly esteemed in others and sufficient demand exists to afford a market for all Venezuelan surpluses. Cazones are caught by hook and line, in gillnets, by haulseines, and by special line trawls or palangres. A considerable increase in catch could be effected with present gear, particularly if shark fishing for livers were carried on simultaneously. Flesh of the cazon is best as a dry-salted product.

Corocoro are now taken in large numbers, usually in conjunction with other species. This species belongs to the grunt family and some individuals attain a length of 15 inches or more. Corocoro are not highly esteemed and are not usually fished for if better-regarded fish are available. The meat is white and flaky and contains some oil. Salted corocoro usually assume a light yellow hue after storage and would be very suitable as fish for export to the Caribbean markets. Examination of several samples of salted corocoro indicated that reddening and molding is retarded considerably. Corocoro are numerous around Isla Coche, Isla Margarita, and from Carupano to Chacopata as well as at other localities. There is no greatly marked seasonal abundance although it is reported that vast schools are sometimes observed. This might be expected since this species is more or less sedentary--concentrations being for spawning purposes. Corocoro would be most suitable for dry salting although they would provide excellent fresh or frozen fillets. Small corocoro, in common with several other little-esteemed species are known as "peces de bulto."

Chicharro is the common name usually applied to a type of sardine, while chicharra is applied to the scad. In this case it is assumed that chicharro refers to the scad a member of the jack family. Chicharro are not highly regarded either as salt or fresh-fish because they are rather small and do not have a great deal of flesh. The meat, however, is white and tasty and makes a good salted product. The fish occur in large schools at irregular intervals during most of the year, but in greatest abundance from about April to September or October. These schools are very seldom, if ever fished, for there is not an extensive market. Dry-salted chicharros should be a very acceptable product for export to Caribbean markets and large quantities could be caught with present methods.

The jurel of Venezuelan waters seems to be the common jack (Caranx hippos). While these fish are caught and used extensively in Venezuela for dry salt-fish, it is doubtful if many Caribbean markets would import them. This is because of the dark, almost black color of the flesh, and the presence of a great deal of oil which quickly oxidizes. In past years, several hundred tons have been exported to Trinidad. The season of greatest abundance coincides with that of the other pelagic species in this zone--from February until July or August. Considerable numbers are taken during other months as well, however. The mainland coast from Carupano west to Puerto de la Cruz seems to offer the best fishing areas. Jurel are caught chiefly in chinchorros, but a few may be taken with handlines. Also, it is reported that jureles will enter a fish pot, even at some depth. Considerably larger catches can be made with present gear and methods.

The variety of fish called lamparosa in Venezuela is without doubt the moonfish (Vomer setapinnis) which has a very compressed body and does not reach an average size of much more than 12 to 14 inches. A considerable catch is taken in this zone and practically all is salted and dried. The flesh is delicate, flaky,, light-colored, and not excessively oily. Dry-salted lamparosa should enjoy a ready market outside of Venezuela. The season and locality of abundance and the migration routes are much the same as have been described previously for the other pelagic species. The largest quantities seem to be taken at Isla Coche and in the Gulf of Cariaco. Practically the entire catch is made in chinchorros--most often mixed with other pelagic species of fishes. The lamparosa is really at its best as a fresh-fish for the flesh is very delicately flavored, white, and flaky. Some increase in production can be attained with present nets and fishing methods.

The names lisa and lebranche are both applied to several species of mullet (family: Mugilidae). Lisa is usually the term for fish of the smaller sizes. Large mullet are called lebranche all along the coast except in Lake Maracaibo where they are called lisa. These mullet are of the same general type as the mullet found in the southern United States except that in Venezuela the lebranche attain a much greater length. Lisa average 12 to 15 inches in length and lebranche 24 inches or more. The larger sizes are preferred in Venezuela and little use is made of the small and medium-sized fishes except as bait. The flesh is off-white in color, sometimes it tends to be somewhat soft but still is flaky and usually quite attractive. Oftentimes large fat deposits are found in the belly. Bones are not numerous. Mullet are found almost universally along the coasts of Eastern Venezuela and are particularly abundant in the Gulf of Cariaco, in the Unare and Tacarigua Lagoons and at places around Isla Margarita and Isla Coche. Usually fish observed jumping in the harbors are mullet. During most of the time mullet are found close inshore and they are taken in large numbers in the Unare and Tacarigua Lagoons. Lisa and lebranche are now dry-salted extensively and the resultant product finds a ready sale in Venezuela but becomes quite dark and oxidized after a short storage period. It is not a particularly good dry-salt product although it could probably be sold in export markets. Probably brine-salting would result in a much better product in Venezuela as it has elsewhere. Mullet are now caught chiefly in atarrayas and chinchorros. The enormous runs of mullet during the periods of "ribazon" at Unare and Tacarigua are well known and attract fishermen from distant points year after year. The only type of gear permitted is the atarraya. If other nets, such as chinchorros or filetes were licensed to fish during certain controlled periods, total production could be increased greatly.

Machuelo are now usually thrown away when caught and are, as far as known, never fished for even though large quantities could be and are caught incidental to the capture of other more-favored varieties. The machuelo of Venezuela is a thread herring (Opisthonema oglinum). It averages 10 to 11 inches in length and is similar in form to the shad (Alosa sapidissima). The flesh is similar to that of herring and shad, being off-white in color and somewhat soft but flaky. Bones are not as numerous as in shad or herring, however. Machuelo seem to appear more or less regularly throughout the year with the largest schools in the period from July to August. The best areas are around Isla Coche and Isla Margarita with indications that the mainland from Carupano westward might also be good. Machuelo should be suitable both for dry salting and for brine salting. The present fishing gear and methods, if a demand is established, could take large catches.

Pampano are not important fishes in Venezuela. Several species come under this name, but they all belong to the jack family. The period of abundance and location of capture are more or less the same as for lamparosa. Most pampano are now taken incidentally with other species. Dry-salted pampano would be salable on the Caribbean market. Practically the entire catch is taken in haul seines. Pampano, of course, are much esteemed as fresh-fish, particularly in the United States. Their use as a dry salt-fish during normal times would be inefficient. It would be much better to quick freeze this species for export.

The picua of Venezuela is a member of the barracuda family--probably Sphyraena barracuda. Although there is widespread prejudice in the Caribbean area in regard to eating this fish, this feeling seems to be lacking in Venezuela. The picua has rather attractive flaky white flesh with only a small oil content. It makes one of the best dry salt-fish products. It probably could be sold on the Caribbean market as it is now sold in Venezuela.

Most picua are now taken by hook and line but occasionally they are also caught in haul seines. Since they are more or less solitary animals it is probable that the catch cannot be increased greatly.

Raya are taken in rather small amounts. The same seems to be applied to several species of skates or rays. The flesh is attractive and when dry-salted it is a good substitute for imported cod. The appearance of reddening seems to be delayed. Dry-salted rays would be salable on Caribbean markets but it is doubted that the catch can be greatly increased because of the more or less scattered occurrence of these animals. Raya are now taken in chinchorros, by harpoon or by handline.

The roncador of Venezuela is a variety of grunt. Relatively few are caught in Venezuelan waters since it is not a particularly esteemed fish; catches that are made are incidental. The flesh makes a good dry-salt product that would be salable on the export market. The bulk of the production now comes from haul seines. Little is known of the seasons or areas of abundance.

Zapatero are little cared for in Venezuela. This fish is the leather jack (Oligoplites saurus) and it occurs rather extensively in this zone. It averages slightly over 12 inches in length. Large schools are often observed around Isla Coche and Isla Margarita. This fish is taken along with other species in haul seines but is seldom used. Experiments should be made to determine if this fish would be suitable as a dry-salted product. If so, fairly large quantities can be obtained.

Tiburon is the name applied to a number of species of large sharks. In general what has been written previously in regard to cazones also refers to tiburones. If properly prepared the flesh is excellent as a dry-salted product and it should be readily salable on most Caribbean markets.

Western Zone

Under-utilized varieties in the Western Zone are many and include curbina, lisa, palometa, pez-espada, bagre, cazones, tiburones, and other species.

It is estimated that seven varieties of fish most abundant in the Maracaibo region could give an annual production of about 5 million kilos. This would be an increase of 4,460,591 kilos or about 9,813,300 pounds. Other less important varieties would add sufficient to total 10 million pounds of surplus for export.

The curbina is now perhaps the most important fish in the Maracaibo region and considerable quantities are taken. In spite of this fact, however, it is certain that increased catches could be made if additional or greater markets were available. The estimated increase could best be obtained with the present type of gear, i.e., gill nets.

The curbina, which belongs to the drum family, averages about 24 inches in length. It is somewhat similar to the channel bass of North America's east coast. The flesh is white, quite rich, gelatinous, and flaky in texture. Tremendous runs of curbina enter Lake Maracaibo usually in March or April, but the species may be taken the year around, sometimes in considerable quantities. Four to five million pounds are now dry-salted and sold annually in the Andes. The keeping quality, however, is not good due to poor preparation. This fish makes a good dry-salted product but might be better brine-salted or canned. The bulk of the yield is now caught with filetes (gill nets) and increased catches would be possible with this same type of gear.

Lisa are abundant in Lake Maracaibo and are taken in quantities for dry salting. The catch, however, could be increased utilizing present gear. Lisa could be utilized best as brine-salted fish and they may be taken during practically the entire year.

There are two types of fish called palometa in Lake Maracaibo. Relatively few are now captured but many more could be produced if markets for them existed. One type of palometa is a carangid or jack, similar to the leather jack. The other type is a characin. The former is taken in waters of higher salt concentration than the latter. The average length of both varieties is 10 to 12 inches. The flesh is attractive and both types would probably make good salted products--either dry-salted or brine-salted. They may be taken practically throughout the Lake Maracaibo area, and are reported to school at certain seasons. There is no doubt that large catches can be made with gill nets or haul seines.

Pez-espada are to be found in relatively large quantities from Paraguana to Goajira, including Lake Maracaibo. They are now taken to some extent, but larger catches could be made with existing gear, chiefly gill nets and harpoons. This fish is a sawfish (Pristis) and attains a very large size--sometimes as much as 12 to 15 feet in length. The flesh is very white, flaky, and not oily and has no taste or odor reminiscent of shark. The

flesh has a relatively high water content, and red flesh is found along the lateral line. Experiments conducted by the mission disclosed that sawfish flesh, properly salted and dried, makes a first-class product equivalent at least to high-grade white codfish. Bacterial reddening, as far as can be learned, is absent or very negligible. One company is now engaged in salting this meat. Hydraulic presses are used to expel some of the moisture after preliminary salting and the pressed fish is then sun dried. The product, however, is relatively high-priced and production is not great.

Many types of bagre are to be found in Lake Maracaibo but they are seldom produced except for the very lowest-priced markets. Enormous quantities could be taken with present gear. All the bagre in the lake are catfish--some marine and some brackish-water species, and sizes range from 7 to 8 inches up to 2 or 3 feet. The flesh is white, rich, and flaky. Bagre may be taken in quantities during the entire year. They would probably be best prepared as a low-priced dry salt-fish.

Table 15 - Actual 1942 and Estimated Potential Production of Salt-Fish in the Western Zone of Venezuela

Variety	1942 Production	Estimated Potential Production
Curbina (drum)	309,686 kilos	1,500,000 kilos
Lisa (mullet)	88,356 "	1,000,000 "
Palometa (characin or carangid)	17,422 "	250,000 "
Pez-espada (sawfish)	7,410 "	750,000 "
Bagre (catfish)	280 "	500,000 "
Cazon (shark)	107,331 "	500,000 "
Tiburon (shark)	8,924 "	500,000 "
Total	539,409 kilos	5,000,000 kilos

Tiburones and cazones are now taken in only insignificant numbers, chiefly for liver oils. The catch could be increased with present gear and much more could be caught with the addition of some specialized gear. They occur widely in the area and can be taken during the entire year. The flesh of all types is white, somewhat fibrous and tough, but not oily. The characteristic "shark" odor can be overcome by a simple technique provided refrigeration is available. Shark meat would be best dry-salted, and as far as is known reddening does not occur. When correctly prepared it can compete with high-grade salt cod, but it is not as good a product as dry-salted pez-espada.

In addition to the species listed above there are many other species in both eastern and western Venezuela which could be produced commercially, depending on markets and prices. Practically all Venezuelan species are now under-utilized. The ones listed above are abundant and are comparatively little used in a commercial sense.

DEVELOPMENT OF NEW AREAS

New areas that can be developed with present methods and facilities are few. While unused or underused fish populations are present, their development would require the establishment of new facilities and service.

SALT

Present salt-producing capacity is ample to care for practically any increase in demand. Salt from the Araya works, near Cumana is generally conceded as the best in Venezuela for fish-salting purposes. The analyses of this salt indicate that chemical impurities are contained in relatively small quantities but that too much insoluble material, such as dust and grit, is contained.

Under a special permit, salt for the fisheries may be purchased at Araya at Bs 3.50 for a sack of 50 kilos (about $21.00 U. S. per ton of 2,200 pounds). Under present conditions, however, the average fishermen is not able to travel to Araya to obtain his salt and must secure it from a middleman. Prices then rise and often fishermen have to pay from Bs 6 to 9 per 50 kilos ($36.08 to $53.90 U. S. per ton).

It is understood that Venezuelan law states that, for industrial purposes salt may be sold at Bs 2.00 per 50 kilos ($12.00 per ton). So far this has not been applied to salt for the fisheries; it should be. Equivalent grades of salt in other countries sell for about $10 to $12 per ton and it is understood that costs of production at Araya are sufficiently low to enable the Government to sell at Bs 2.00 per 50 kilos and still make a small profit. Cheap and abundant salt is a prime necessity for a salt-fish industry.

The Ministerio de Agricultura y Cria is now initiating a project whereby deposits of salt will be established at all major salt-fish producing centers. Prices will be based on Bs 3.50 per 50 kilos, and freight and handling charges will be added to the price at the deposit. This is a most useful development and it should be pushed to completion. The Venezuelan Government also should endeavor to cut the base price at the salt works to Bs 2.00 per 50 kilos, if possible. Although the chemical purity of the salt is satisfactory for the preparation of salt-fish products for consumption in Venezuela and nearby Caribbean countries (Trinidad, Curacao, Aruba), its bacterial purity is not. Practically all solar-evaporated salts contain "salt tolerant" (haliophilic) microorganisms which, if not controlled, will affect markedly the appearance and ultimate keeping quality of salted fishery products through the formation of "reddening". This condition is not restricted to Venezuela alone. Reddening has plagued the salt-fish industry of the world for many years and is still a serious problem. Salt-fish producers have tried various methods for controlling reddening--among them: (1) the sterilization of salt, (2) sterilization of saltery equipment, and (3) the addition of chemical inhibitors to salt and salt-fish.

The need for controlling reddening, under the present conditions, for fish sold in Venezuela has not been emphasized since most fishery products are sold and consumed locally before serious reddening occurs. However, an increase in salt-fish production for local consumption (necessitating storage) and for export will make it mandatory that some control be instituted, since fish as now prepared have a storage life of only three to six weeks--not long enough for those export markets into which these products may find their way. Control measures used at present in other salt-fish producing countries may have to be modified or new ones developed, for the Venezuelan industry is operated under entirely unique conditions and improper or inadequate control may add to the final cost of the products to make production for export economically unsound.

Experiments are now under way at the United States Fishery Research Laboratory at Mayaguez, Puerto Rico, to determine the best means for controlling reddening.

Depending upon the results obtained in the experiments on reddening, it may be necessary to process and condition the salt obtained at Araya. This may take several forms. It may necessitate the sterilization or baking of salt to destroy the reddening organism; if so, the salt works at Araya has a dryer that could be used in this connection. It may be found necessary to add a chemical inhibitor to the salt. This might also be done at Araya. As a last resort it may be necessary to re-crystalize the salt. With certain new equipment this could also be done at the salt works. Naturally, these conditioning operations would increase the cost of the salt. The benefits derived from these operations, however, would more than offset the slight additional cost of the salt and if the conditioning were efficiently handled on a large scale the costs need not be high.

Even if it were necessary for the Government to subsidize part of the production and conditioning costs of salt the benefits accruing to the fishing industry and to the country would be well worth the expense.

STUDIES TO CONTROL "REDDENING"

It is evident that control of "reddening" is the most important factor in determining if Venezuela is to become a producer of salt-fish for export. Although producers of salt-fish in other countries take certain precautions to reduce the development of the coloration, it is found that application of similar measures to Venezuela under existing conditions of the industry would be impossible from the standpoint of costs and practicability. A simple, not too costly control is desired, since practically all salting is carried out at fishing camps by fishermen in a multitude of scattered and isolated localities and too

much divergence from the traditional salting methods, developed over a period of centuries, is considered impractical. Toward this end, the mission initiated studies at the Fishery Research Laboratory of the United States Department of the Interior at Mayaguez, Puerto Rico. The general program of research on the control of reddening follows:

1. Isolation of the red organisms from Venezuelan salts.

2. Testing of chemical preservatives against pure cultures of the red organisms for killing or inhibitory powers.

3. Sterilization of salts to destroy the organisms.

4. The use of sterilized salt for salting fish.

5. The use of mixtures of sterilized and unsterilized salt with chemical preservatives for salting fish.

6. The use of chemical preservative solutions for dipping fish previous to salting.

7. The development of a procedure for the combination of a chemical dip and/or mixtures of salt and chemical preservatives if found necessary.

Preliminary results of the studies indicated that several preservatives are effective in inhibiting the growth of the red organism and steps are being taken to prepare mixtures of sterilized and unsterilized salts with the effective chemicals for shipment to Venezuela for use in preparing experimental lots of salt-fish. Like lots of fish will be prepared by the methods now in use and all samples will be returned to Puerto Rico for observations on their keeping quality and development of reddening.

Until the studies on the control of reddening are further advanced, large-scale production for export to distant markets should be held in abeyance. There is opportunity, however, to commence salting operations, namely, with cazones, tiburones, rayas, and pez-espada. These are very resistent to reddening and are salable in Caribbean markets. (A more complete study of the bacterial reddening problem appears as a supplement to this report.)

CONTAINERS

Packaging for Venezuelan salt-fish products falls into two major categories--for dry-salt products and for brine-salt products.

Local industries can supply two suitable types of containers for dry salt-fish plus a third which may or may not be suitable. Of these, wooden boxes can be manufactured but at relatively high prices due to the cost of lumber. If container costs can be added to the basic fish prices for export the Venezuelan salt-fish industry can be supplied with a sufficient number of boxes made locally. As an excellent substitute, heavy baskets of wild cane (cana amarga) could be procured in a sufficient quantity to package dry salt-fish. The raw material is abundant; many women already know how to make baskets, and the prices would be low. Suitable baskets should be more or less cubical in form, to hold about 100 kilos of dry salt-fish. They should be supplied with covers that can be woven on. The spaces between the woven strips should be as small as practicable. Some dry salt-fish is now packed in burlap sacks but this is not regarded as suitable for long-distance transport.

Water-tight barrels as now manufactured in Venezuela are not suitable in quality, quantity, or price for packing brine salt-fish. While suitable woods are obtainable for local cooperage industries, machinery is not available and prices of wood are very high. If a large part of the production of fish for export from Venezuela would be as brined fish, suitable barrels would be necessary. At this time, the only alternative is to import staves, heads, and hoop materials, and the necessary assembling machinery. When interior transport again becomes less expensive it is quite possible that a local cooperage industry could be set up.

LABOR

Sufficient labor in all categories is available at reasonable costs. It is possible that some managerial and supervisory personnel can be obtained in Venezuela but operations and policy control may have to be handled by persons selected from abroad. These persons must be fully grounded in all phases of production, processing, and marketing of fishery products and must have a full realization of the peculiar conditions in the Venezuelan fisheries.

TRANSPORTATION

Adequate local transportation is available for movement of processed fish from the rancherias to shipping centers. This could be improved by the addition of goletas or tres punos, preferably with auxiliary engines, for moving relatively large quantities of fish.

If additional transport vessels are required they may be procured from boats already afloat or built in local yards.

PORTS

Existing ports are quite suitable for any operations contemplated in this section. Probably Cumana and Maracaibo could be employed as collection centers. Salt-fish could then be exported direct from these ports or shipped by sea to La Guaira or Puerto Cabello for export.

WAREHOUSING

Present warehouses could adequately handle the increase of production envisioned in this section. There is ample storage space both at the rancherias and ports for more salt-fish products. If temporary storage facilities over and above these are required they can be built of locally made bricks, tiles, and lumber.

REFRIGERATION AND ICE-MAKING

Since existing facilities are to be used, there is no particular need for increased refrigeration or ice-making plants in connection with the development of salt-fish surpluses on the scale contemplated in this section.

MERCHANDISING

At the present time there are no large dealers or handlers of salt-fish. These products are most often handled by small operators who buy the fish from the fishermen and then carry it to consuming centers where it is sold either to wholesalers or retailers.

It is probable that, given a steady export market demand for salt-fish surpluses, several long-established houses, experienced in the handling and distribution of foodstuffs, would enter the field, provided the products meet the standards for export and that prices paid are sufficiently attractive. Such companies could organize local production and collection for transport to a shipping point where grading, inspection and packing would be performed. A United States Government agency could then purchase such fish under suitable agreements and arrange for its transportation and distribution to the export market.

Definite controls would be required to insure that salt-fish necessary for Venezuela itself, would not be exported. It would be unwise to export any fish which do not truly represent an exportable surplus. Prices of fish for export should not exceed prices paid locally for home consumption.

METHODS OF PREPARATION

Dry-Salted Fish.—The mission visited fish production centers all along the coast of the Venezuelan mainland and outlying islands to study local methods of salt-fish preparation and to suggest improvements where feasible.

All types of dry-salted fish as prepared by methods now in use were found to be acceptable for present local consumption. The Venezuelan market, in general, prefers fish with a high oil content and dark color such as Spanish mackerel or kingfish (carite), bluefish (anchoa), jack (jurel), and false albacore (cabana). Fishes of this type are said to be "rico" (rich) and they add considerable flavor to favorite dishes. On the other hand, consumer preference in other Caribbean markets (notably Puerto Rico) is for those species which are generally known as "non-oily" varieties, such as grunt (corocoro), snapper (pargo), snook (robalo), drum (roncador), sawfish (pez-espada), and shark (cazon). In order to clarify a common misconception in regard to consumer preferences for fishery products in the Caribbean area, it should be stated that fish which exhibit a yellowish color and which have a pronounced "codfish" (bacalao) odor are generally preferred. Not only is salt-fish a dominant food in supplying protein needs, but it also serves as a flavoring agent for starchy and rather tasteless foods such as rice, beans, and yams.

From experiments and observations made in the field the mission found that the method of dressing fish as practiced by the fishermen was satisfactory. However, more care should be exercised in washing the dressed fish to remove more thoroughly the blood, viscera, and extraneous matter. Experiments also showed that the fishermen should use thirty percent of salt by weight of fish instead of the usual twenty-five percent. A "finer" grade of salt should be used to allow for more rapid and complete penetration. Salt penetration could be further assured if water-tight containers such as barrels or tanks (tanques) were used more generally. The fish, after striking, should be stacked in piles on frames elevated from the ground and weighted down to press out brine before being placed out to dry (water horsing or kenching). This practice will assure more complete drying and may also serve to inhibit reddening to some extent.

Experiments also show that shade drying will produce a lighter appearing product and delay the red coloration. Drying time, however, was prolonged by two days in the experiments conducted by the mission at Cumana. Shade drying should therefore be practiced only in preparing a higher-quality product where lightness of color is an important consideration.

For species such as shark, sawfish, and others that have flesh composed of dark and white meat, it is suggested that the dark meat be separated from the white for the preparation of two grades of products. The flesh should be cut into longitudinal pieces about 1/2 inch thick. The connective tissues of the flesh are less visible and salt will penetrate more thoroughly when flesh is cut longitudinally.

It has been found that if fish are dried to a lesser water content reddening will be delayed. From 30 percent moisture downward, reddening ceases to be a serious problem as long as the moisture content in the stored fish does not rise greatly. Fish as now processed in Venezuela could be dried more completely for export, and by so doing reddening may be delayed for a long enough period to enable such fish to be sold on export markets.

Brine-Salted Fish.--Experimental packs of brine-salted arenque, lisa, machuelo and curbina were prepared by the mission. The procedure used for lisa, curbina, and machuelo follows: The fish were split down the back along the backbone from the head to the tails so that they would lay out flat. Heads, viscera, and stomach membranes were removed. A horizontal gash was made under the backbone on the thick portion of the flesh side and the flesh scored longitudinally. Fish were next immersed in clean sea water and soaked for about half an hour. Blood, slime, and extraneous matter were washed off with sea water and salt was applied under the backbone in all cuts, and over both surfaces of each individual fish. The salted fish were placed flesh side up into clean, water-tight barrels with salt sprinkled over each layer of fish. Thirty-five percent salt by weight of fish was used (35 pounds of salt to each 100 pounds of raw fish).

After three days the fish were repacked into clean, water-tight barrels, flesh-side up, each layer of fish at right angles to the layer below. The barrels were headed and saturated brine was added through the bung hole to completely fill the barrel. Filled barrels were stored in a cool, shady place when possible.

For arenque the procedure was the same with the exception of the dressing operation. Arenque were dressed by holding the fish in the left hand, belly side down, and cutting behind the head in such a manner that the viscera was removed with the head. The fish were washed in sea water and placed in the barrel with alternate layers of fish and salt.

These samples were shipped to Puerto Rico for examination. In each case the brine had assumed an "off" color and odor. Reddening of the flesh occurred to some degree in every sample. Under present conditions brine-salted fish do not seem to keep for longer than one month. Further investigation may develop a means for preparing brine-salted fish which will keep over a longer period. Sterilization of the salt, admixture of chemical inhibitors in the brine, and storage in cool warehouses would all be useful in better preservation.

INSPECTION

A system of inspection must be adopted for products intended for export. Fish should be graded according to species, size, moisture content and color. The smaller species may be packed together but care should be exercised to segregate the oily species from the lean ones. The fish should be packed carefully to avoid excess physical damage during shipment, and a careful check on the net weight should be made. The moisture content of each lot should be determined before shipment. A small moisture determination laboratory should be provided for this purpose. Adequate inspection invariably leads to satisfied customers and very often increases profits. The world salt-fish trade at the present time is disrupted and favorable for the entrance of new producers. These producers, however, should take advantage of this opportunity to establish good relations with importing markets by supplying good products at reasonable prices. By doing so, resumption of normal competitive conditions will not seriously affect the chances for Venezuelan producers to remain in business. Attempts to amass unjust profits and to dispose of poor quality products under stress of emergency conditions can only result in a virtual termination of the export trade when normal conditions again apply.

FINANCING

Under operations contemplated in this section no great amount of money would be required, since present facilities and methods are to be utilized. Necessary financing costs would include office, collection, handling, and packaging. Ample local private capital is available for any purposes contemplated in this section.

To cope with the necessary transportation, purchase, and distribution problems from Venezuelan shipping points to the ultimate consumers, interested United States Government agencies might set up a small purchasing and service unit in Venezuela. If this were not feasible, local enterprise could sell direct to agents in other countries with transport by present available means or in some cases by Venezuelan-owned carriers.

In order to assure interested parties in Venezuela of success it would be advisable to make firm offers or contracts for specified varieties, quantities and delivery times. Quality should also be specified by the purchaser. Under present shipping conditions Venezuelan enterprise would doubtless desire to sell their products FAS Venezuelan shipping point.

MATERIALS REQUIREMENTS

The only materials requirements would be sufficient cotton-twine, hooks, chicken-wire, leader-wire, nails and boat-building supplies, tools, canvas, and other materials to maintain the present fishing fleet. To this, if brine-salted fish were required, would be added barrel staves, heads, and hoops and the necessary barrel-assembling apparatus. To make more efficient collection and transport to and from the warehouses, it may be necessary to arrange priorities for several diesel engines of about 175 to 250 horsepower. These engines would be installed in schooners already afloat. Shafts and propellers would probably also be required. An itemized statement of requirements is listed below. (Furnished by the Ministerio de Agricultura y Cria.)

Materials Requirements for Maintenance of Present Fisheries of Venezuela

1. Chicken wire for fish pots.

   300 rolls; galvanized No. 16 wire; special weave with 2" mesh. Each roll 50 yards long and 72" wide.

2. Wire for assembling pots.

   3,000 pounds of plain iron galvanized wire No. 20. Rolls of 1/2 pound each.

3. Hooks.

   400 each eyed 3" hooks.
   40,000 each No. 6.
   40,000 each No. 7.

4. Copper wire for trolling.

   400 rolls No. 20.
   400 rolls No. 21.
   400 rolls No. 22.

5. Seine twine, hard laid.

   50 pkgs. No. 6.
   50 pkgs. No. 9.
   50 pkgs. No. 12.
   50 pkgs. No. 15.
   50 pkgs. No. 18.
   50 pkgs. No. 21.
   50 pkgs. No. 24.
   50 pkgs. No. 27.
   50 pkgs. No. 30.
   50 pkgs. No. 45.
   50 pkgs. No. 60.
   50 pkgs. No. 72.

6. Seine twine, medium laid.

   500 pounds No. 4.
   1000 pounds No. 12.
   1000 pounds No. 16.
   1000 pounds No. 20.
   500 pounds No. 24.
   500 pounds No. 32.

OPERATING SCHEMES

As contemplated in this section all local activities such as production, collection, processing, handling, transportation and warehousing would be handled by local companies. Interested United States agencies would make appropriate arrangements with present or projected companies to buy, at fixed prices, FAS Venezuelan port, exportable surpluses of fishery products of specified types and quality, packaged according to specifications, over a given period of time.

SECTION B

WITH OVER-ALL ORGANIZATION, GRADUAL MODERNIZATION OF EXISTING FACILITIES AND METHODS, DEVELOPMENT OF NEW FISHERY AREAS, AND THE ADDITION OF NEW FACILITIES AND PRODUCING METHODS

PRODUCTION

The present needs of Venezuela for fishery products are calculated to be about 100 million pounds in the round as landed. With the changes and development set forth in this section a potential total catch of about 400 million pounds is possible. The increase, approximately 300 million pounds as landed, would be more or less equivalent to 75 million pounds of processed fish, chiefly as dry salt-fish.

To reach the upper limit of the above potential in production, however, will require at least several years and possibly longer, depending upon such factors as the continued abundance of fish, producing costs and selling prices, market demands, ability of Venezuelan fishermen to assimilate new techniques, management, technical direction, availability of machinery and supplies, and on other factors.

It is calculated that the Isla Margarita - Gulf of Cariaco area can contribute about 150 million pounds of this total; the Gulf of Venezuela - Goajira, and Lake Maracaibo areas, approximately 100 million pounds, offshore fisheries outside and around Los Roques and other off-lying islands, about 50 million pounds; the Gulf of Paria and Orinoco Delta region, about 50 million pounds, and other now under-developed areas, lagoons and the Central Zone altogether, about 50 million pounds. It is emphasized, however, that while these production figures may be reached or even surpassed, they represent a very optimistic view in the judgment of the mission and as stated above, would be dependent on the favorable outcome of a series of interdependent factors.

CONVERSION OF FISHING GEAR AND CRAFT

To attain the production contemplated rather sweeping changes will be necessary, both in fishing gear and in boats. It cannot be emphasized too strongly that introduction of new methods and equipment must be gradual and that the effect on the over-all economy of the fishing communities must always be taken into serious consideration.

Fishing Gear.—In the Eastern Zone the way is already prepared for the introduction of the simpler and smaller types of pelagic seines—the lampara, ring-net, and purse-seine. At least three individual attempts have been made to operate such gear; and, in spite of generally inefficient nets, techniques, and boats, results have been uniformly promising. That they have not been continued in operation has not been due to failures of the method, but rather to extraneous circumstances including lack of a market demand sufficiently large and organized. The traditional method of fishing chinchorros has produced enough fish to supply the market and there has been no great stimulus to adopt other methods. Also, difficulties in financing and obtaining the necessary engines and other equipment for boats capable of fishing pelagic seines have acted as a deterrent. Finally, lack of knowledge as to the actual construction and operation of such nets and of the boats to fish such nets has been a barrier to their adoption.

The present fishery is predominantly a chinchorro fishery and this limits the fishable water in the area to a relatively narrow coastal strip, probably not more than 300 to 500

meters from the beach. In addition, surf conditions and rocks render many areas unfishable to chinchorros. Thus, the fishermen must now wait until the schools of fish come within range of the seine before a set can be made. While numerous schools may be just a little further offshore they cannot be taken with the present nets, and often many schools may pass into the Gulf before one comes close enough inshore to be set upon. This is generally true throughout the Eastern Zone and particularly so in the Gulf of Cariaco and around Isla Margarita and Isla Coche. All indications are that the introduction of pelagic seines would be a definite step toward increased production of fish since it would immediately make available many more times the water area which can be fished.

It is considered that the following steps would be most suitable in introducing pelagic seines:

1. That 3 to 6 ringnets be purchased, built according to specifications,[1/] and distributed in the Gulf of Cariaco and at Isla Margarita.

2. That these nets be operated by local fishermen under expert supervision until the former are thoroughly versed in the technique of fishing with them.

3. That experiments be conducted to determine if such nets could be constructed by modifying present chinchorros, and if so that as many as may be desired be made in this way.

4. That necessary twine and other supplies be made available in order that fishermen may eventually make their own ringnets just as they now make their own chinchorros.

Pound nets or traps are used to great advantage in many fisheries where conditions are favorable. There is every reason to believe that such gear could be operated successfully in several areas on the coast of Venezuela. The deciding factor, however, is not whether fish can be caught by this gear, but rather how the fishermen of the coast would react to it. It is the opinion of the mission, from a careful consideration of all the evidence available, that the introduction of traps in any locality where extensive fishing is now engaged in would be unwise since it would certainly interfere directly and indirectly with present activities and would tend to force out the majority of small fishermen. However, it is quite possible that traps could be installed in areas not now fished, such as the Gulf of Paria, without undue adverse reaction. Such traps might also be installed in certain more or less isolated regions in Lake Maracaibo, the Goajira, Paraguana, the shores of the Gulf of Venezuela, and in certain places in and near the Orinoco Delta.

Since traps have never been used in Venezuela, their introduction would require expert assistance from foreign sources and also considerable experimentation as to localities, methods of construction, and materials to be used. Possibly the occurrence of sharks and other large, voracious fish will make the upkeep of trap webbing difficult. In this case it may be necessary to utilize heavy, wire-screening in the leads. Wooden poles and locally made rope are available in Venezuela.

A great deal has been said for and against the use of otter trawls in tropical waters. In general, bottom fish are sparse on clear bottoms in these regions. Where fish are to be found the bottom is rocky or otherwise unfishable due to coral structures. On the Venezuelan coast, however, there are indications that trawling might be successful in certain favorable areas. This type of fishing has been tried on several occasions. Off La Guaira the nets were lost due to the rough bottom. Some fish, however, were caught but not of the types sought--pargo, mero, and other first-class species. In the Gulf of Venezuela a large European type trawl was used with some degree of success. Again, however, the types of fish taken were not of salable species for the Venezuelan markets of that time. This net, also, was eventually lost. There was no incentive to continue fishing with trawls. During the field studies of the mission in Lake Maracaibo a small trawl was constructed and operated. Good indications for further shrimp and flounder fishing were obtained.

1/ Specifications suggested are: 150 fathoms long and 15 fathoms deep.
Bag: 125 fathoms long, 1" stretched mesh No. 6 cotton twine.
Landing Bag: 10 fathoms long (centered in bag) 1" stretched mesh No. 9 cotton.
Wings: each 12 fathoms long 6" stretched mesh No. 9 cotton.

According to the reports of individuals who were engaged in trawling in the Gulf of Venezuela, large catches were obtained. The species, however, were grunts, flounders, and other non-esteemed types and there was no market for their sale.

These previous experiences indicate that trawling should at least be considered, particularly in the Lago de Maracaibo, the Gulf of Venezuela, off Tacarigua and Unare Lagoons and in the Gulf of Paria. While the species taken might not be salable on Venezuelan fresh-fish markets they would certainly be usable as dry-salted fish and possibly frozen fish for export.

For experimental and developmental stages of trawling it would be unnecessary to import large vessels or nets. As a matter of fact it might be best to develop smaller nets which could be used by sailboats or small motorboats.

In the opinion of the mission, the most suitable method for developing the trawl fishery would be as follows:

1. Acquire a 50 to 60 foot shrimp or flounder dragger from the United States east coast.

2. Acquire at least two small trawls[1] for its use.

3. If experiments are successful, obtain designs for small trawls of above type and construct locally.

4. Nets can be built locally copying above.

5. Develop smaller nets for use by sailboats.[2]

It is quite possible that an extremely rich shrimp population will be found. If so this would furnish the basis for industrialization by canning, drying, freezing, and salting.

Trolling and live-bait fishing is now carried on by fishermen in the Isla Margarita region. While the techniques are good, the yield is comparatively small because of the small boats used. Larger boats, preferably motorized, can be used for both types of fishing and the catches would be much larger. In trolling, outriggers should be used and by this means nine or more lines can be fished. Venezuelan fishermen are well acquainted with rigging and fishing by this means. In live-bait fishing the bait fish can be carried in a well or in a deck tank. In the latter case a small water pump would be necessary. With larger boats more men could fish and the catch would be greater than at present.

Handlining is a universal type of fishing in Venezuela. At present it is usually conducted not far from shore and usually in water up to 50 fathoms. (Some Coche fishermen get down to 100 fathoms or more.) Since only small sailboats are used at present the grounds must be fairly close to shore. If larger vessels, up to 60 feet, of the tres punos type, equipped with a small diesel auxiliary were used, the fishing radius could be extended and grounds, now practically virgin, exploited. Such vessels could be equipped with an insulated hold for carrying ice to preserve the catch. The fishermen could fish directly from the mother ship or from small rowboats or dories, a number of which could be carried aboard. This type of activity would probably produce fish only for the fresh market or for freezing. Such banks as those of Goajira, those between Isla Margarita and Grenada, and others could be fished by these craft.

1/ Specifications: 30 to 40 foot headrope
10 foot wings
Bag to be 1" mesh
Wings -2" mesh
Trawl-lines either cable or rope--preferably rope

2/ For further information on the use of an otter trawl by sailboat and other small craft, refer to an article entitled: "A small otter trawl" by R. T. Whiteleather and H. H. Brown, 1944 (Government Printing Office, Port of Spain, Trinidad. 12 pp.).

Nasas (fish pots) are now in general use, particularly around La Guaira and to the eastward. Because no mechanical power is used in hauling these pots the depths fished are not great. In addition, the small rowboats or sailboats used by pot fishermen do not allow for fishing at any distance from shore. Larger vessels, such as those described under handlining could tend pots on offshore banks. Hauling would be by winch. Calculating 15 minutes as the time required to haul, empty, and set one pot, it should be possible to visit 30 to 40 pots per day. If the pots were hauled on alternate days, two ranges or strings could be fished. Possibly handlining and pot fishing could be engaged in simultaneously by using dories for the handlining. These dories could be set out in the morning and picked up in the evening and would fish handlines in the interval that the mother ship was tending the pots.

It is the opinion of the mission that the present abundance of lebranche in Unare Lagoon will allow for increased fishing by other forms of gear than the atarraya (castnet) now in exclusive use. Possibly filetes (gill nets) could be authorized for fishing in such a way that each fisherman could use only one or two nets and during only a specified time. It is quite evident that much fish are now being lost because the atarrayas are unable to take them; and with the seasonal increases of salinity in the lagoons, many fish die.

CRAFT

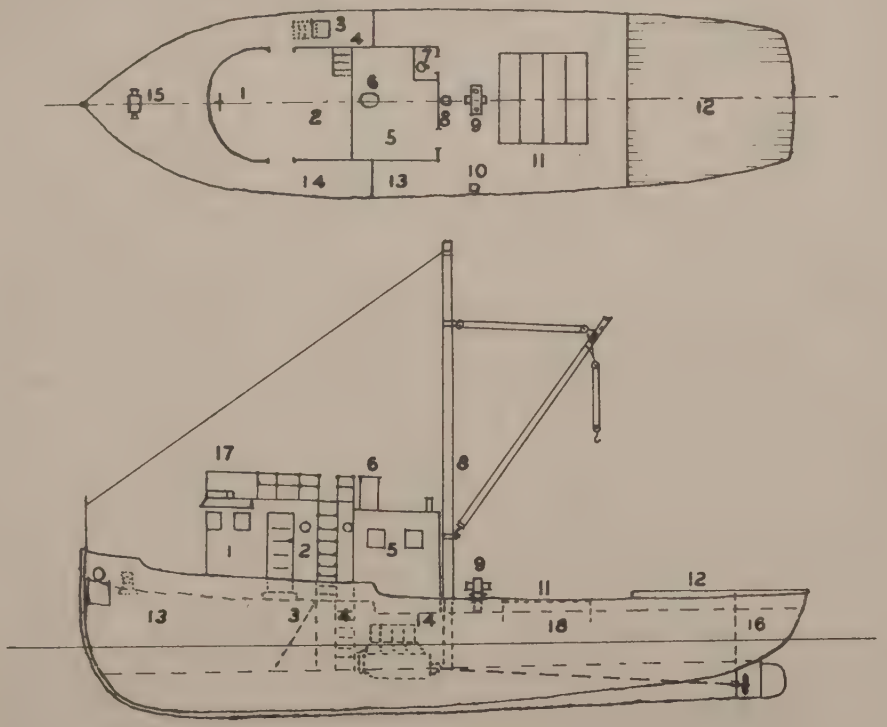
Every type of craft now used in fishing in Venezuela could be made more usable by adding a motor. This, however, would be a Utopian condition and hardly wise or necessary, since the craft now fishing are quite suitable for meeting the present demand.

With the introduction of more productive fishing gear, however, new types of fishing craft will be required. It is the considered opinion of the mission that the introduction of new techniques must be gradual and that the conversion of craft now familiar to the fishermen should be the first step. With this in mind, the large piraguas now used in the chinchorro fishery could easily be converted to powered seine boats. Such craft would then be suitable for sheltered-water fishing, as in the Gulf of Cariaco. Structurally, only the stern part of the present piragua would require change. The stern should be widened, rounded, and lowered. The bow section might also be built up somewhat to make the boat drier. Forward of amidships a small diesel engine of 20 to 40 horsepower should be installed. Working through a power take-off equipped with a clutch, a doubledrum hoist should be installed in the after third of the boat, preferably near the center line. A demountable purse davit equipped with two snatch blocks should be installed on the port gunwale with a fairlead to the hoist. The boat should be partially decked fore and aft, and a short, stubby mast and stout boom should be rigged.

The net, a ringnet preferably, is piled on the stern. A small skiff is used as a seine skiff and the first end of the net is fastened to it. When it is desired to set the net, the seine skiff is cast off from the motorboat and its inertia in the water helps to pull the net off the stern of the motorboat. Conversion of existing piraguas can be accomplished in any of the boat-building centers. If it is not desired to rebuild the piraguas then this recommended type of boat can be built new. The catch of these boats can be landed in unmotorized piraguas and towed to port or it can be brought in by a motorized scow or pickup boat.

As development proceeds, it will probably be found advisable to build larger and more powerful boats with a greater operating radius. These boats could be used for trawling, trolling, livebait fishing, ring-netting, and shark fishing. For handlining and offshore pot fishing goletas or tres punos would be most suitable. As the need and desire arises for larger boats of modern design it would perhaps be best to secure representative types

Figure 3

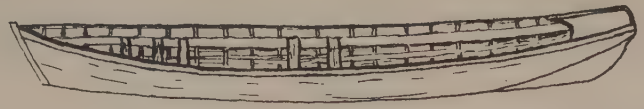


1. PILOT HOUSE
2. CAPTAINS CABIN
3. FORECASTLE HATCH
4. ENGINEROOM HATCH
5. GALLEY
6. FUNNEL
7. TOILET
8. MAST AND BOOM
9. PURSE WINCH
10. PURSE DAVIT
11. FISH-HOLD HATCH
12. NET PLATFORM
13. CREW'S QUARTERS
14. ENGINE ROOM
15. ANCHOR WINCH
16 LAZARET
17 FLYING BRIDGE
18 FISH HOLD

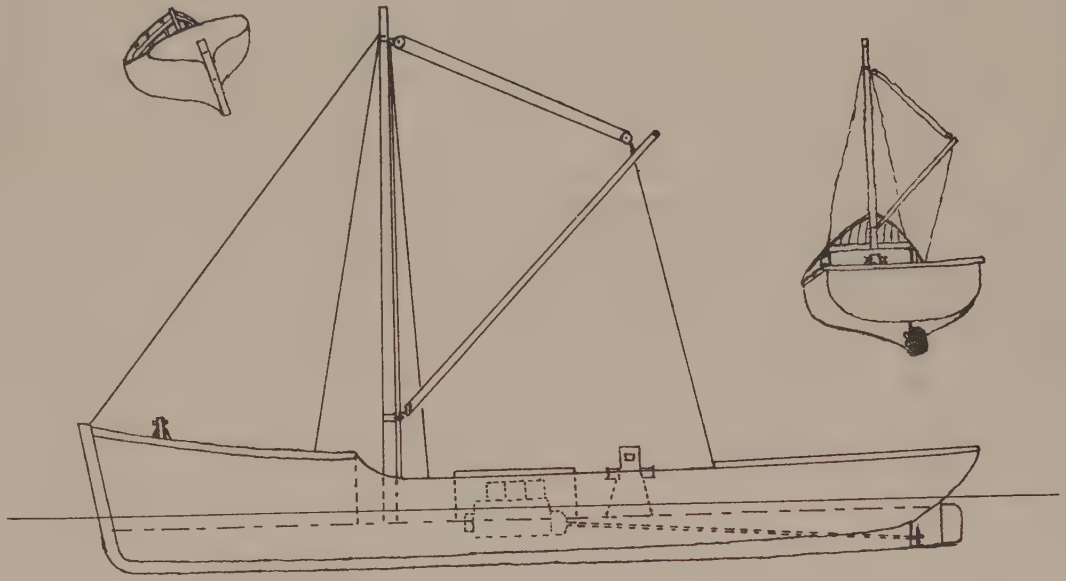
Milton J. Lobell 2/14/64

MULTIPLE PURPOSE FISHING VESSEL

Figure 4



PIRAGUA AS NOW USED IN CHINCHORRO FISHERY



POSSIBLE MODIFICATIONS TO MODERNIZE PIRAGUAS FOR PURSE-SEINE OPERATION

from abroad. It would be possible to have several vessels built according to specifications dictated by Venezuelan conditions.1/ There is adequate reason to believe that a standard type, universal purpose vessel would be best for some time to come. With several such models operating in Venezuela it would be easy for Venezuelan ship builders to copy them and turn out vessels of like type. That this can be done is evidenced by the fact that a fishing vessel 50 feet long, of modern design, is now being completed by a boat builder at Porlamar. This vessel is of excellent design and construction and will be powered by a diesel engine. It is to be used for fishing and for carrying fish to a cannery at Porlamar.

Boats of the standard type described in this section would be able to fish anywhere in Venezuelan waters and would be seaworthy enough to stay out in almost any type of local weather condition. Fishing could be carried on in the Gulf of Venezuela and also off the outlying islands. Since there is a large ice-cooled hold and since the cruising radius is considerable, relatively long trips could be made enabling the vessel to load up before returning to port.

Since there are already existent a considerable number of vessels, some of which are motorized, these could be used in an offshore handline fishery and also for pick-up and supply boats. They should be motorized and should have power on deck. The fish holds should be well insulated and equipped with pen boards. The use of these boats, which are seaworthy and able, is economic, particularly if they are also used for transporting fish to nearby countries such as Trinidad, Curacao and Aruba, and Colombia.

The need in the more sheltered fishing areas is fast, large-capacity fish carriers. This is particularly true on Lake Maracaibo and in the Gulf of Cariaco. A light icing would be sufficient for trips up to six or eight hours. For the present, goletas, tres punos, or piraguas could be used, but any industrialization located at a central point will require carriers more suited for this task. Eventually it may be desirable to build one or more powered scows for carrying fish. These are easy to build and efficient, and cost of construction is not high. Power scows are extensively used in the fisheries in Alaska and they should be well suited to Venezuelan conditions.

DEVELOPMENT OF UNUSED OR UNDER-UTILIZED SPECIES

The addition of new techniques and the development of wider-radius fishing will utilize all species to a greater extent. It will certainly develop the greater use of the pelagic species such as carite, anchoa, cabana, cachorresta, arenque, palometa and many others. It will offer an opportunity to exploit bonitos and tunas well offshore. Tiburones, meros, pargos, and roncadores will be taken in greater quantities in offshore areas then at present. Shrimp fishing should be stimulated tremendously. Lacking definite information on the abundance and availability of fish offshore, it is impossible to assess the contribution that could be made by the now under-utilized species. There is, however, sufficient evidence to indicate that development of offshore fishing would be economically feasible and would probably in time exceed the shore fisheries in importance.

DEVELOPMENT OF NEW AREAS

The introduction of power-driven fishing vessels of extended cruising range will open up extensive new fishing areas and will enable the utilization to a much greater degree

1/ Over-all Specifications

50 to 60 feet over-all: 15 to 20 foot beam. To draw 4 to 6 feet of water. Wood construction, copper or bronze sheathing below water line. To be powered by 80 to 150 H.P. full diesel installed well forward. A doubledrum hoist or winch driven through a power take-off from the main engine. All houses and deck structure well forward leaving after two-thirds of deck open. Bow to be high and flared, stern a compromised purse-seine type, wide and flat in water. Fuel and water tanks for 1,000 mile radius. Mast and boom to be stout and well guyed. Hold space amidships insulated with 8 inches of cork or equivalent. Bilge pump, necessary auxiliaries to be included. Controls to be one man, located in pilot house and on flying bridge. Speed 8 to 12 knots. To be equipped with necessary fittings for trolling, trawling, ring-netting, and shark fishing.

of areas that are now fished. With the exception of a comparatively few pot and handline fishing boats there is now no fishing activity away from the immediate shore except in Lake Maracaibo where filetes are set at almost any spot desired. The introduction, then, of boats and gear which can be operated away from shore will develop many new areas hitherto unfishable with present gear. In addition, almost virgin areas, such as the Gulf of Paria and the Gulf of Venezuela will be available for fishing. Also, it will provide access to new offshore banks now unfished, such as those between Isla Margarita and Grenada.

SALT

The local production of solar salt is ample to take care of increased demand to the extent visualized in this section. However, as pointed out previously, the price of salt at Araya should be lowered to the equivalent of $10 to $12 per ton. The establishment of salt depots throughout the fishing areas is deemed necessary.

If the sterilization and conditioning of salt is found to be advisable, as it probably will be, adequate provision for machinery to do this job must be made.[1/] It is estimated that about 100 million pounds of salt will be required annually to salt the 400 million pounds of fish as landed.

CONTAINERS

One of the most difficult problems to overcome with a great increase in salt-fish production will be that of containers for packing for shipment.

As previously mentioned, wooden boxes in sufficient quantity and suitable quality can be manufactured in Maracaibo. The prices for these boxes, as quoted in December 1943 are too high unless the cost be added to the selling price of the salt-fish. If all the exportable salt-fish were to be packed in 90 kilogram capacity boxes, about 375,000 boxes would be required. In order to produce this number of boxes it would be necessary to make special arrangements with several sawmills in Maracaibo and to furnish assistance in obtaining the needed supplies, such as truck tires for maintaining transport of the logs from the logging areas. At the quoted cost of box shooks, Bs 6.90 for each box, plus transport, nails, and making costs, the cost of each completed box would be about Bs 7.50 and 375,000 would cost Bs 2,812,500 or $843,750. These prices presuppose the use of jabillo which is the type of wood now used for boxes and which is about the cheapest wood available.

For a low-cost container suitable for packing dry salt-fish, baskets constructed of cana amarga (bitter wild cane) could be used. Since the making of such baskets is now a cottage industry, organization of supply of raw material, weaving, and construction would be necessary in order to obtain the large number needed. Since these baskets can be built to hold 90 kilos, 375,000 of these would be needed. It is estimated off-hand that such baskets could be purchased at about Bs 1.00 each--possibly less. In this case no nails would be necessary but transportation from the manufacturing points would have to be supplied. Such baskets would be much less expensive than wooden boxes, and for all ordinary purposes just as usable and sturdy.

Whether fish packed in brine can form any large part of the potential Venezuelan exports remains to be determined, since experimental packs made by the mission in the field indicate that such products do not keep well. If technological difficulties can be overcome in the preparation of brine-salted fish with requisite keeping qualities, water-tight barrels of around 70 kilos (150 pounds) must be obtained, at least for the present, from the United States. Prices quoted in October-November 1943, indicate that suitable barrels were available at a calculated price of about $3.00 (Bs 9.00) each, laid down in La Guaira in knock-down form. Assembly machinery would have to be secured. Suitable barrels are not

1/ Rotary steam - jacketed ovens with agitators to handle 25 tons per hour would be necessary for the sterilization of the salt required for salt-preserved fishery products. Rotary "baffle type" mixers to handle 25 tons per hour would also be required if chemical inhibitors such as boric acid or others are added to the sterilized salt. A valuable adjunct to the sterilizing and mixing machinery would be salt-grinding machinery that would produce a "finer" grade of salt. In general, the size of the salt crystals is much too coarse for use in salting fish. More rapid and complete salt penetration would result if a salt of finer grain were used.

now made in Venezuela and the basic cost of lumber would militate against setting up coperage machinery at this time, since the finished product would be relatively costly.

Even if it were found that brine salt-fish cannot be successfully prepared in Venezuela, some barrels would be required. It is proposed in a succeeding part of this section to utilize such containers for a specific purpose. In this case the barrels would not be expendable but would be used again and again. It is estimated that at least 20,000,150-pound capacity barrels will be required for this purpose.

LABOR

With a gradual modernization of the present industry, manpower to operate more producing units will become available. It is the opinion of the mission that there will be sufficient fishermen to produce the increased catches. With a definite assured demand and fair returns to the primary producer, former fishermen now working at other occupations will probably go back to fishing. Since the primary labor for salting the fish is already on hand at the various rancherias it is probable that the proposed increase in production can be handled. Again, as in the case of the fishermen, stimuli accorded by firm market demands and fair returns will bring more labor into the fishing industry. There would be no problem in over-all training of such labor since it is already conversant with basic operations. Modifications of the present techniques, however, will necessitate definite understandings with the owner or head man in each locality in order that the primary preparation may be carried out according to required specifications.

Captains and crews for pick-up and supply boats are available and well acquainted with Venezuelan coastal waters.

Labor for secondary processing, finishing, and packing centers is believed to be available to the extent needed. Both male and female help would be required and almost all of the labor operations contemplated do not require extensive skill or long training. Adequate supervision, however, must be supplied, and it is believed that personnel to do this can be recruited.

Technical and managerial personnel present a greater difficulty than ordinary labor. Although no complicated machinery is to be used, with the exception perhaps of the artificial driers, motors, and generators, skilled engineers or practical mechanics will be needed. Since the proper processing and finishing of the dry salt-fish will require definite control by a competent technician, such personnel must be acquired--probably from abroad. Managerial personnel must be fully acquainted with every phase of the salt-fish industry--not only as regards Venezuela but also as regards export markets and other producing countries. Venezuelan managerial personnel would be very suitable to handle problems under the direction of a general manager with the above-stated qualifications.

In summation, then, it can be stated that every type of labor and technical skill is now to be found in Venezuela with the exception of the top, directing positions. These positions necessitate training, experience, and knowledge which cannot now be secured in local personnel.

TRANSPORTATION

To care for the increase in production, a definite transport system must be organized. With additions to present motorized vessels such operations can be successfully carried out. It is estimated that at least three motorized vessels of 75 to 100 tons would be required in the Eastern Zone, two in the Gulf of Venezuela-Paraguana area, and possibly two others to care for other areas. These transports would carry empty barrels and other supplies to the rancherias and would carry filled barrels and fish to the secondary processing points. They would also be used in carrying finished fish from the processing point to the shipping points. Larger fishing vessels will be able to transport raw fish in their own holds to processing points.

At a later date it may be found advisable to acquire several powered scows for use in transporting fish from the rancherias to the secondary processing points.

Since it is assumed that the salt-fish is to be purchased FAS Venezuelan port no international transportation will be required of Venezuelan producers. If transportation from Venezuela should become necessary, large schooners of the type previously mentioned could be used for carrying fish to countries in the Eastern and Central part of the Caribbean.

PORTS

No new ports would have to be established. However, secondary processing plants will require a location where carrying vessels will be sheltered. A dock and certain facilities, such as fresh water and diesel oil lines, loading and unloading mechanisms, will be necessary at the plants. Such plants would preferably be located at Cumana-Caiguire and Maracaibo. FAS shipping points could be La Guaira, Puerto Cabello, Maracaibo, and Cumana.

Loading and unloading at rancheria points can be best handled by using present means although a small dock at any of these would be a great advantage.

WAREHOUSING

To adequately store the output as contemplated in this section special warehouses are to be built. In general, possible warehousing up to two months must be expected. This would probably amount to storage space for about 15,000,000 pounds of cured fish. Of this amount, part would be stored at the plant and part at the FAS shipping point. To store this amount of fish packed in containers about 1 million cubic feet will be required, allowing for ventilation and working space.

Such warehouses should be constructed as open as possible in order to take advantage of prevailing breezes. The floor should be of concrete and such walls as are used may be made of locally produced brick--possibly faced with cement. The roof would preferably be constructed from imported, composition corrugated sheets. The roof supports would be of structural steel or possibly local wood. The fish in baskets or barrels or in piles should be kept off the floor by means of low platforms made of wood under which and through which air can circulate. With spaces between all boxes or baskets, these could be stacked three or four high. Adequate handling and shipping facilities should be provided, as well as the necessary tables, and sorting facilities.

If, at a later date, brine salting is engaged in, cooled warehouses may be required (cooled to about 45°F.). Preferably these would be operated in conjunction with an ice plant and freezer.

REFRIGERATION AND ICE MAKING

While such equipment is not strictly required for the operations contemplated, it would be an excellent plan to include such a plant since ice in quantity may be needed in some cases. Also it might be advisable to use refrigerated brine in some of the processing stages. Finally, cool storage of brine-salted and some classes of dry salt-fish might prove necessary. In addition, an auxiliary business of fresh and frozen fish would be an excellent extension of operations since certain species such as anchoa, pampano, pargo, and shrimp are worth much more in the fresh or frozen state than as salt-fish.

For the present requirements and looking forward to increased needs, a 20-ton capacity compressor should be adequate for ice manufacture and for cold storage and brine refrigeration. These plants should be attached to and operated in conjunction with the salteries.

SUGGESTED IMPROVEMENTS IN PREPARATION

As contemplated in this section, the methods of salt-fish preparation would be modified to include practices that are in use by producers in other countries to retard reddening.

Among these practices are:

1. The use of fresh water for washing dressed fish.
2. The use of sterilized salt.
3. The use of mined salt.
4. The use of boric acid.
5. The periodic sterilization of saltery equipment.
6. The more thorough drying of salt-fish.
7. The storage of salt-fish at reduced temperatures.

It is known that fresh water will not support the growth of the organism responsible for reddening. Washing in fresh water should produce unfavorable conditions for organisms that may be present on the fish as contaminants from the water in which th fish were caught. Further washing in a light brine (3 to 4 percent) made with sterilized salt to remove blood should be carried out.

Various investigators have demonstrated that the organisms responsible for reddening are present in solar-evaporated salts; thus heat treatment of salts previous to use in the salting procedure would eliminate one of the principal sources of the red organisms.

Mined salts are free from the red organisms. Their use has b en advocated at times for fish salting, but because of the presence of chemical impurities, higher cost, and adverse appearance, taste and texture of the finished product, they are not used extensiv ly by salt-fish producers. Their use is not recommended for Venezuela.

A mixture of finely ground salt (sterilized) and boric acid is sometimes used by salt-fish producers as a means of retarding reddening. It is generally applied to the fish previous to packaging. Chemical preservatives are permissible in foodstuffs provided they are not toxic per se. Boric acid is recommended to reduce the degree of reddening. Although fish treated with this chemical eventually turn red its use is recommended until such time as better chemical inhibitors are found, or methods of processing so improved that preservatives will not be required.

Periodic sterilization of saltery equipment such as barrels, tanks, flakes, scales, tables, etc., with flowing steam is recommended to keep down contamination of the fish by the red organisms. This measure is practiced by many salteries in the Western Hemisphere.

Practical experience indicates that dry-salted fish of a low moisture content (30 percent or less) will not redden as rapidly as fish with a higher moisture content (30-45 percent). For this reason more thorough drying should be practiced.

Storage of dry-salted fish in cool, well-ventilated warehouses also retards reddening. The organisms grow best at temperatures ranging between 37-55 deg. C. and belong to that group known as thermophilic (heat tolerant) organisms. Lower storage temperatures will therefore prolong keeping quality by reducing the growth rate of the organisms.

The application of these measures, either wholly or in part would necessitate a change in the system of producing salt fish as practiced at present. The new system may possibly take the following form: A central processing plant (Fig. 5) could be provided. Watertight barrels containing fresh water for washing dressed fish would be transported to the fishing camps. Sterilized salt would be furnished to fishermen for salting fish in barrels. No fish drying would be carried out at the fishing camps—instead the fish salted in barrels would be returned to the central plant for further processing where the fish would be removed from the barrels, partially dried in the atmosphere and further moisture removed either by presses or hot-air dryers or both. Final moisture content of dry-salted fish should be in the region of 30 percent. Previous to packaging, fish would be sprinkled with a mixture of finely ground sterilized salt and boric acid. One part boric acid to 99 parts of salt should be tried. Packaged fish would then be placed in a cool, well-ventilated warehouse.

A weekly sterilization of saltery equipment would also be desirable. This could best be done by thoroughly washing all equipment with fresh water followed by a treatment with live steam.

The adoption of these measures will undoubtedly add to the cost of the final product. How much cost would be involved cannot be stated exactly. Costs and procedure could best be tested by the operation of a pilot plant before going into large-scale production.

The feasibility of producing brine-salted fish on a large scale could also be determined by pilot plant operation. Only fresh-fish should be used for salting. All blood and viscera should be carefully removed and sterilized salt used throughout the preparation. Thirty-five percent salt by weight of fish should be used. Storage in refrigerated rooms would aid considerably in prolonging keeping quality.

QUALITY OF PRODUCTS AND INSPECTION

Quality is an important factor in establishing firm export markets. Food inspection officials of countries into which fishery products are imported enforce rigid standards for quality. Standards vary for different countries, but in general include the following:

1. Salt-fish products must be free from "reddening" or nearly so. Salt-fish are frequently disallowed from entering certain countries because of this condition.

2. Salt-fish products must be wholesome. The presence of foreign matter such as sand, stones, weeds, etc., is not allowed; also improper cleaning and presence of gills, stomach contents and the like are not permitted.

3. Fish products cannot be adulterated by poisonous or deleterious substances.

4. Misbranding is not allowed. Contents must be stated clearly on the containers.

5. Packaging must be adequate and sanitary.

Strict adherence to standards should be practiced by producers to protect markets in the postwar period. Laxity in quality standards will only result in loss of markets.

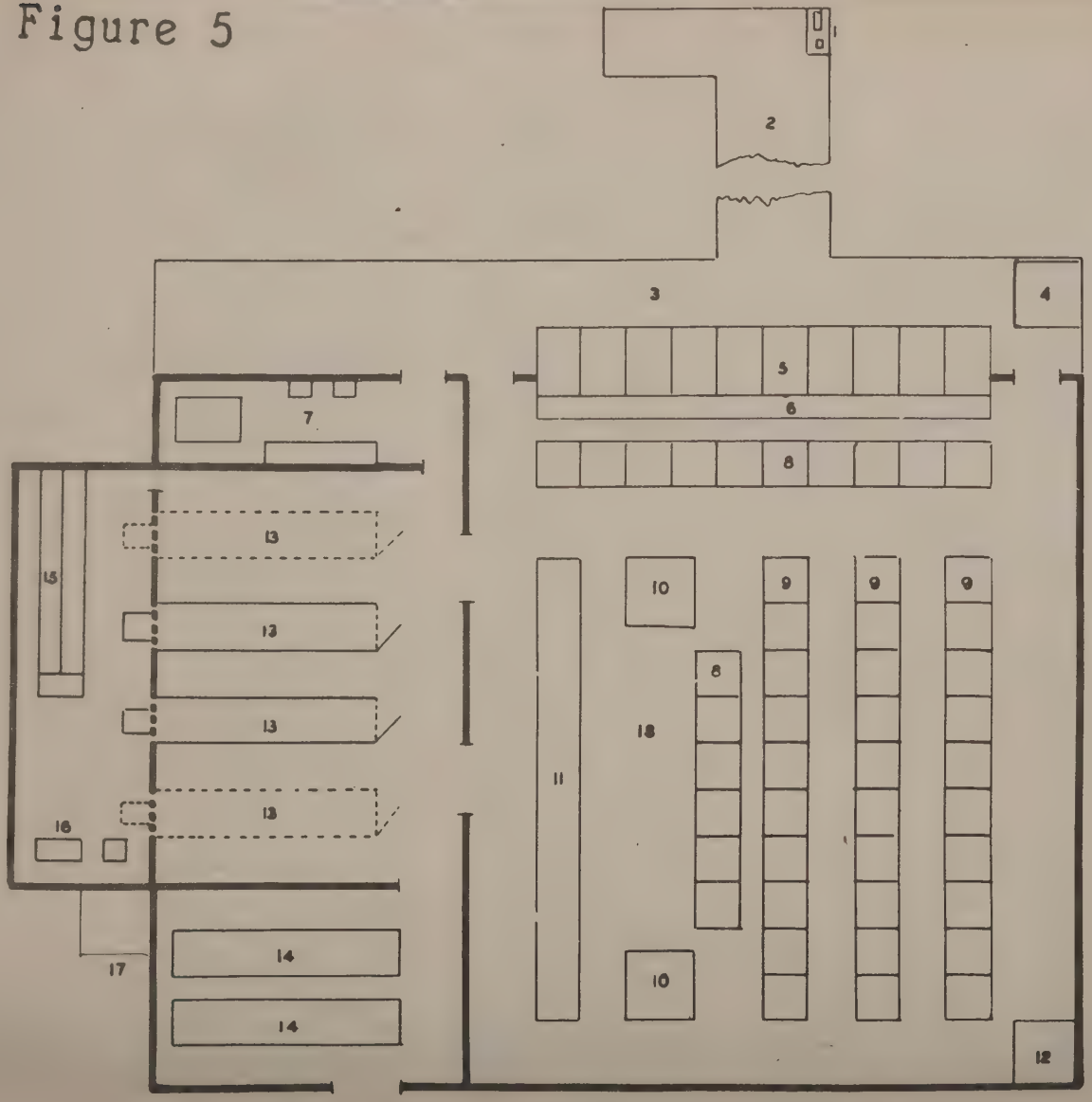
The application of the various practices to control reddening should enable the preparation of a product of good quality that would have a ready demand by consumers in the Caribbean area and elsewhere.

Fish should be graded according to species, size, moisture content, and color. Oily species should be segregated from the lean ones. Containers should be of adequate strength to prevent excess physical damage to the contents. Moisture determination on each lot should be carried out before shipment. As mentioned in a previous section, a small moisture determination laboratory should be provided for this purpose.

MERCHANDISING

Operations within the scope presented in this section will require that one or more local companies be set up or contracted with to expand operations to engage in this business. These companies would set up salteries, would contract with fishermen for partially prepared products by specification, would supply the fishermen with salt, barrels, and other necessities, would operate transport boats, would construct and operate warehouses, and would guarantee to deliver at designated shipping points, specified quantities and qualities of salt-fish. It is assumed that some agency of the United States would then take over the production FAS Venezuelan shipping point according to previous arrangements. United States Government agencies would assist in obtaining materials and supplies and would furnish technical assistance as required.

Figure 5



1. PUMP FOR SEA-WATER
2. DOCK
3. APRON
4. SEA-WATER STORAGE TANK
5. RECEIVING HOPPERS
6. CLEANING TABLE
7. SALT CONDITIONING ROOM
8. WASHING TANKS
9. PROCESSING TANKS
10. PRESSES
11. LOADING TABLE
12. BRINE STORAGE TANK
13. TUNNEL DRYER
14. FINISHING TABLE
15. BOILER
16. ENGINE GENERATOR
17. FRESH-WATER STORAGE TANK
18. KENCHING AREA

0 1 2 3 4 5 6 7 8 9 10

METERS

FISH SALTING AND DRYING PLANT

FINANCING

From information gathered by the mission it appears that financing of companies to engage in this field could come from private Venezuelan sources. Since the original outlay in capital would be fairly great, definite assurances in the form of contracts might have to be given provided the quality of the products could be guaranteed.

It is estimated that land, buildings, docks, machinery, floating and other equipment would cost in the neighborhood of $300,000 to $600,000; with salt supplies, barrels and other operating supplies, about $150,000 additional. These costs are only estimates but they include at least two central processing plants with necessary equipment.

MATERIALS REQUIREMENTS

It would be impossible, at this time, to give exact materials requirements. However, a general list of items which must be imported is given herewith.

Building Materials:

roof trusses
I-beams for roof supports
reinforcing bars
cement
corrugated composition roofing
water pipe - for salt and fresh water
spigots, tees, elbows, etc.
electric cable, sockets, switches, outlets, etc.
sash and door frames
sanitary equipment

Vessel Equipment:

diesel engines
diesel auxiliaries, clutches, shafting, bearings, gears
shackles, thimbles, chain, swivels, turnbuckles, etc.
shafting
propellors
bronze or copper sheeting
nails, screws, fastenings, rivets
anchors, chains
toilets
steering quadrants, wheels
sail canvas
boat builder tools - hand and machine
miscellaneous boat fittings and supplies
canvas

Plant Equipment and Machinery:

overhead rail-conveyor systems
hand trucks
weighing scales
drying fans and coils
steam or electric water pumps
electric motors
boilers
generators
barrel-assembly machinery
salt retorts

Plant Equipment and Machinery: (continued)

salt grinders
salt mixers
refrigeration machinery
themostatic and humidity controls
moisture determination laboratory

Fishing supplies:

hooks
chicken wire
twine, cotton
leader wire
ringnets, assembled
small trawls, assembled
purse rings, swivels, etc.

COST AND PRICES

To illustrate, a sample project is set up, based on figures obtained during the field work of the mission.

A Sample Project

Location of plant: Cumana, Venezuela.

Capacity: 2,000,000 kilos of dry-salted fish (based on the output of four 2-ton capacity tunnel dryers operating 12 hours per day for 250 days).

Potential capacity: 4,000,000 kilos if plant is operated on a 24-hour day.

Production of 2,000,000 kilos of dry-salted fish (30 percent or less moisture content) with four 2-ton tunnel dryers working 12 hours per day for 250 days per year.

1. Cost of fish:

In barrels supplied by company with salt furnished by company. Fresh water will also be furnished by company in barrels delivered to the rancherias. Species of fish to be corocoro, machuelo, lamparosa, cazon, tiburon, lebranche, lisa, chicharra, cuna, burro, cachicato, pampano, picua, barbuda, roncador, and others. Filled barrels will be collected in vessels of the company and replaced with empty barrels. Fish will be cleaned and wet salted in barrels at the rancherias according to specifications and purchase price will include this service.

Average price..... Bs 0.20 per kilo of fish (about 60 percent moisture) (about $0.027 per pound)

4,000,000 kilos..... Bs 800,000

2. Barrels: To be re-used and sterilized after each use.

1,000 each 70 kilos capacity..... Bs 10,000

3. Salt:

To be purchased at Araya and delivered to plant for sterilizing, grinding and conditioning. Will be supplied to fishermen in quantities consistent with their sales of salt-fish to company.

1,000,000 kilos at Bs 0.10 per kilo..... Bs 100,000

4. Transportation:

This includes carriage of empty barrels, salt, and other supplies to rancherias and return of filled barrels to plant. Three "tres punos", each of 50 to 60 tons will be required.

Crew's wages:

3 captains	Bs 18,000
3 engineers	10,800
6 sailors	4,800
Total	Bs 33,600
Upkeep and operation of vessels	Bs 15,000
Total	Bs 48,600

5. Plant operations:

To include unloading, sorting, washing, finishing, dipping or conditioning, kenching, pressing, and drying in tunnel dryers, packing, warehousing.

Labor: (250 days per year)

20 women at Bs 2.00 per day	Bs 10,000
6 men at Bs 4.00 per day	6,000
6 men at Bs 5.00 per day	7,500
Total for labor	Bs 23,500

Containers:

20,000 baskets at Bs 1.00 ea.	Bs 20,000
Salt, chemicals, water, fuel oil, etc	Bs 30,000

Management and control:

General Manager, foreman, accountant and others	Bs 50,000

Miscellaneous:

Travel, etc	Bs 10,000
Total	Bs 133,500

Capital Investment

Vessels: 3 "tres punos", 50 to 60 tons each, motorized with diesel engines.

Each, about Bs 40,000 ..... Bs 120,000

Trucks: 1 stake body ..... Bs 10,000

Plant: Building and dock

2,000 M^2 at Bs 150 per M^2	Bs 300,000	
Tanks, tables, benches, etc	15,000	
Conveyors, hand trucks	10,000	
Tunnel dryers, 4 at Bs 10,000	40,000	
Presses, 2 at Bs 5,000 each	10,000	
Boiler, pumps, motors, generators, etc	20,000	
Salt kiln, grinders, mixers, etc	15,000	
		Bs 410,000

Revolving fund:

For purchase of fishing supplies and materials which will be sold to fishermen at reasonable prices	Bs 30,000	
For purchase of food, clothing, etc., for advance to fishermen	10,000	
For purchase of salt, barrels, baskets, chemicals, fish, etc	360,000	
		Bs 400,000

Operating reserve:

For emergency	Bs 60,000
Total capital outlay	Bs 1,000,000
	$300,000 U.S.

SUMMARY

1. Selling price of products, FAS Puerto Sucre (Cumana) Moisture content 30 percent or lower.

2,000,000 kilos at Bs 0.876 per kilo (about $0.12 per pound)	Bs 1,752,000.00

2. Cost of production, FAS Puerto Sucre.

Cost of fish	Bs 800,000	
Barrels	5,000	(amortized over 2 years)
Salt	100,000	
Transport	48,600	
Plant operations	132,250	
Total		Bs 1,085,850.00
Gross gains	Bs	666,150.00

Amortization of capital outlay for replacement and repair

Vessels:	5 years	Bs 24,000 per year
Truck:	3 years	3,500 " "
Plant:	5 years	82,000 " "
Total	Bs 109,500 per year	
Gross gain	Bs 666,150	
Amortization	Bs 109,500	
Net gain	Bs 556,650	

OPERATING SCHEMES

Since it is obviously impossible to anticipate every detail which might be encountered in establishing and operating a salt-fish industry of this magnitude, the following outlines of operations can only be suggested:

A. Organization:

1. Formation, financing, organization of company.
2. Determination of standards for export and submission of offers to interested buyers.
3. Firm agreements as to quantity, quality, and other factors with buyers.
4. Appointment of field representatives in Cumana, Maracaibo and elsewhere if necessary.
5. Designing of plants, docks, warehouses and procurement of land.
6. Procurement of machinery, supplies, materials, vessels, personnel, labor.
7. Construction of plants, buildings and preparation for operation.
8. Working agreements with armadores, fishermen, and other primary producers.
9. Instruction of armadores, fishermen and other primary producers as to preparation methods and standards.

B. Operation:- When the above points have been completed, actual operation may commence.

1. Scheduling of transport boats to various points.
2. Furnishing barrels, conditioned salt, and other essentials to fishermen, armadores, and other primary producers.
3. Picking up filled barrels and replacing them with empties.
4. Delivery of filled barrels to plant.
5. Cleaning, washing, processing, and finishing and packing at plant.
6. Transporting finished product to shipping point and warehousing.
7. Company fishing operations to level production, if necessary and advisable.

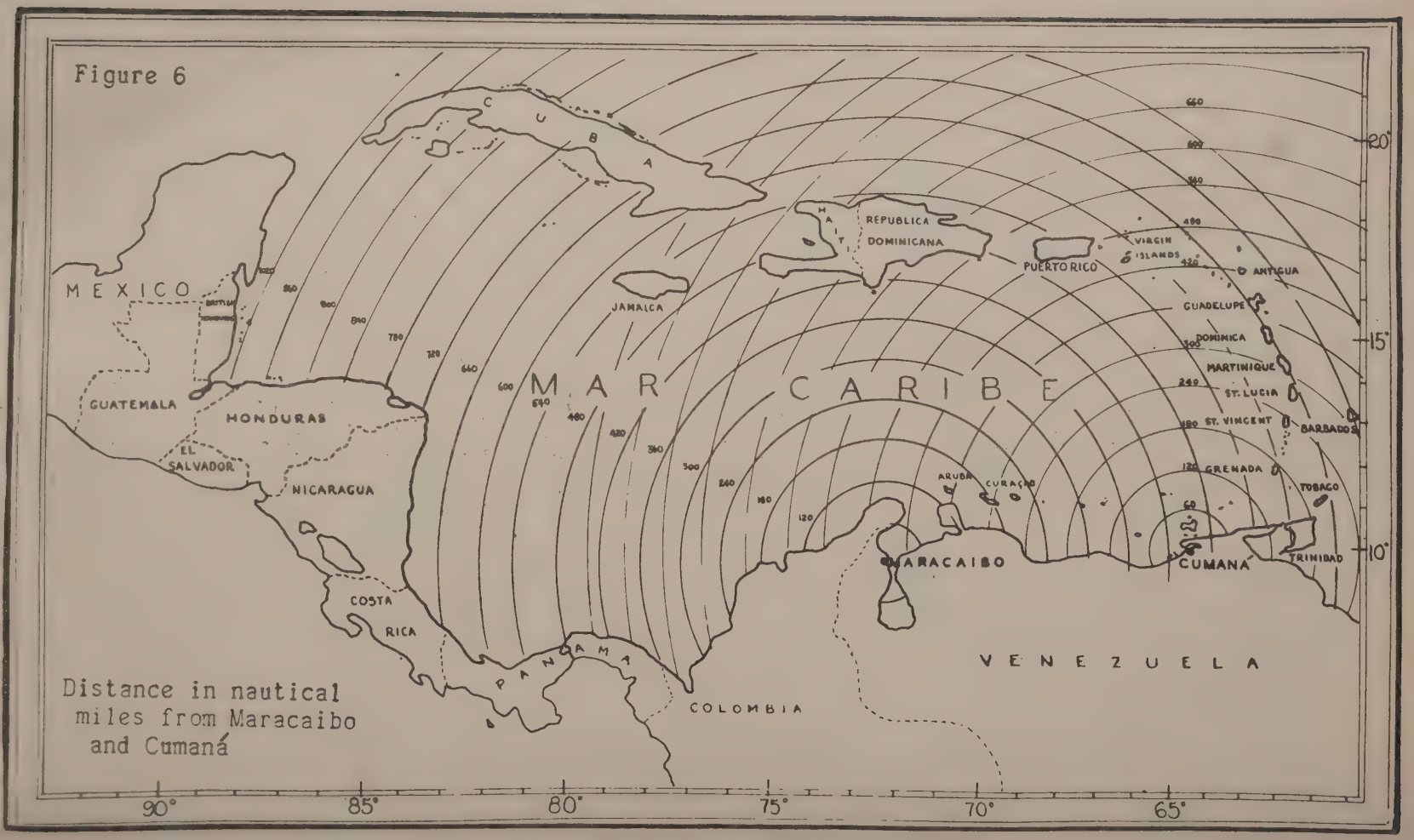


Figure 6
MEXICO
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
COSTA RICA
PANAMA
COLOMBIA
VENEZUELA
CUBA
JAMAICA
HAITI
REPUBLICA DOMINICANA
PUERTO RICO
VIRGIN ISLANDS
ANTIGUA
GUADELUPE
DOMINICA
MARTINIQUE
ST. LUCIA
ST. VINCENT
BARBADOS
GRENADA
TOBAGO
TRINIDAD
ARUBA
CURAÇAO
MARACAIBO
CUMANA
MAR CARIBE
Distance in nautical miles from Maracaibo and Cumaná
90°
85°
80°
75°
70°
65°
20°
15°
10°

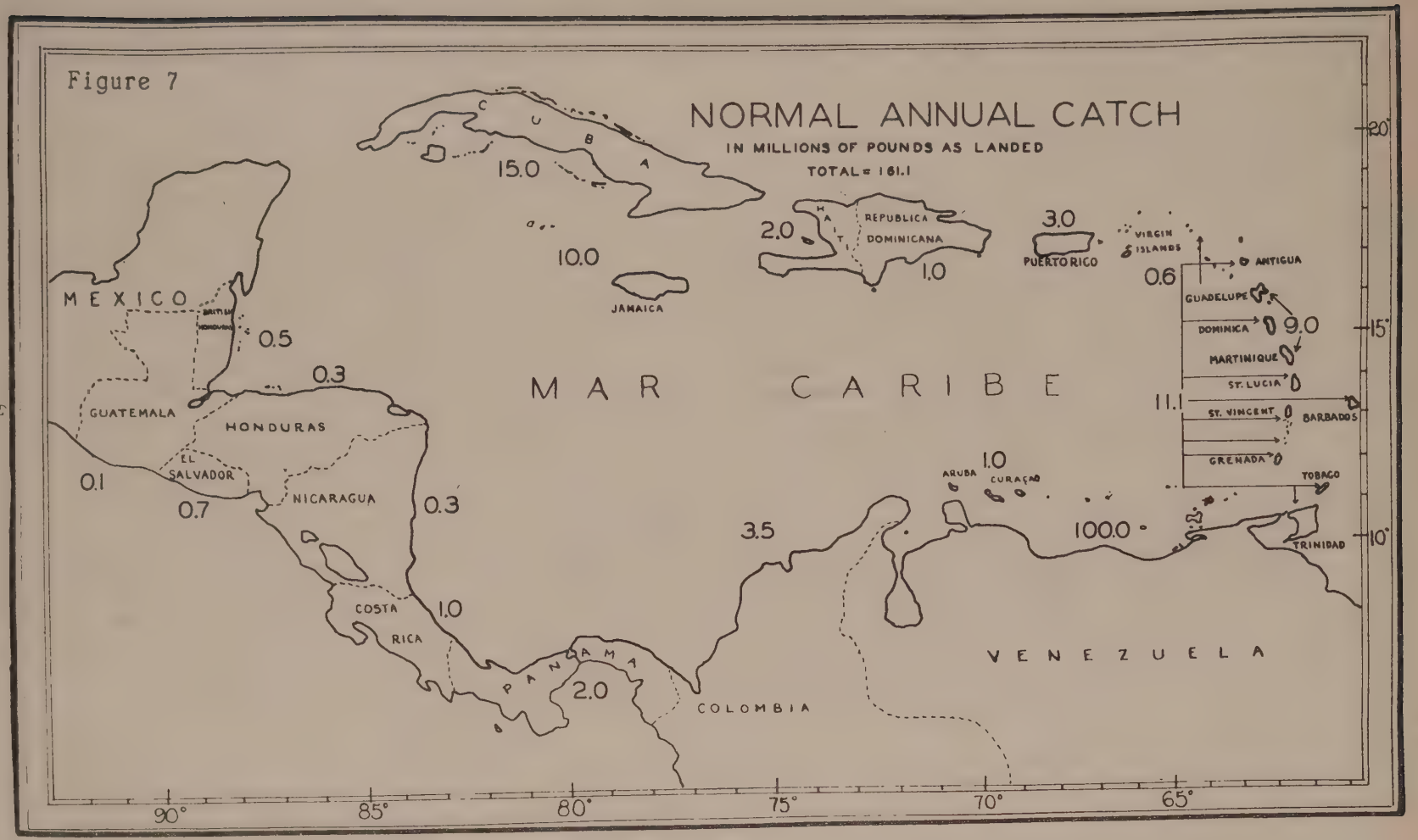


Figure 7
NORMAL ANNUAL CATCH
IN MILLIONS OF POUNDS AS LANDED
TOTAL = 161.1
CUBA
15.0
10.0
JAMAICA
HAITI
REPUBLICA DOMINICANA
2.0
1.0
PUERTO RICO
3.0
VIRGIN ISLANDS
ANTIGUA
0.6
GUADELUPE
DOMINICA
9.0
MARTINIQUE
ST. LUCIA
11.1
ST. VINCENT
BARBADOS
GRENADA
TOBAGO
TRINIDAD
100.0
ARUBA
CURAÇAO
1.0
3.5
MEXICO
BRITISH HONDURAS
0.5
0.3
GUATEMALA
HONDURAS
EL SALVADOR
0.1
0.7
NICARAGUA
0.3
COSTA RICA
1.0
PANAMA
2.0
COLOMBIA
MAR CARIBE
VENEZUELA
20°
15°
10°
90°
85°
80°
75°
70°
65°

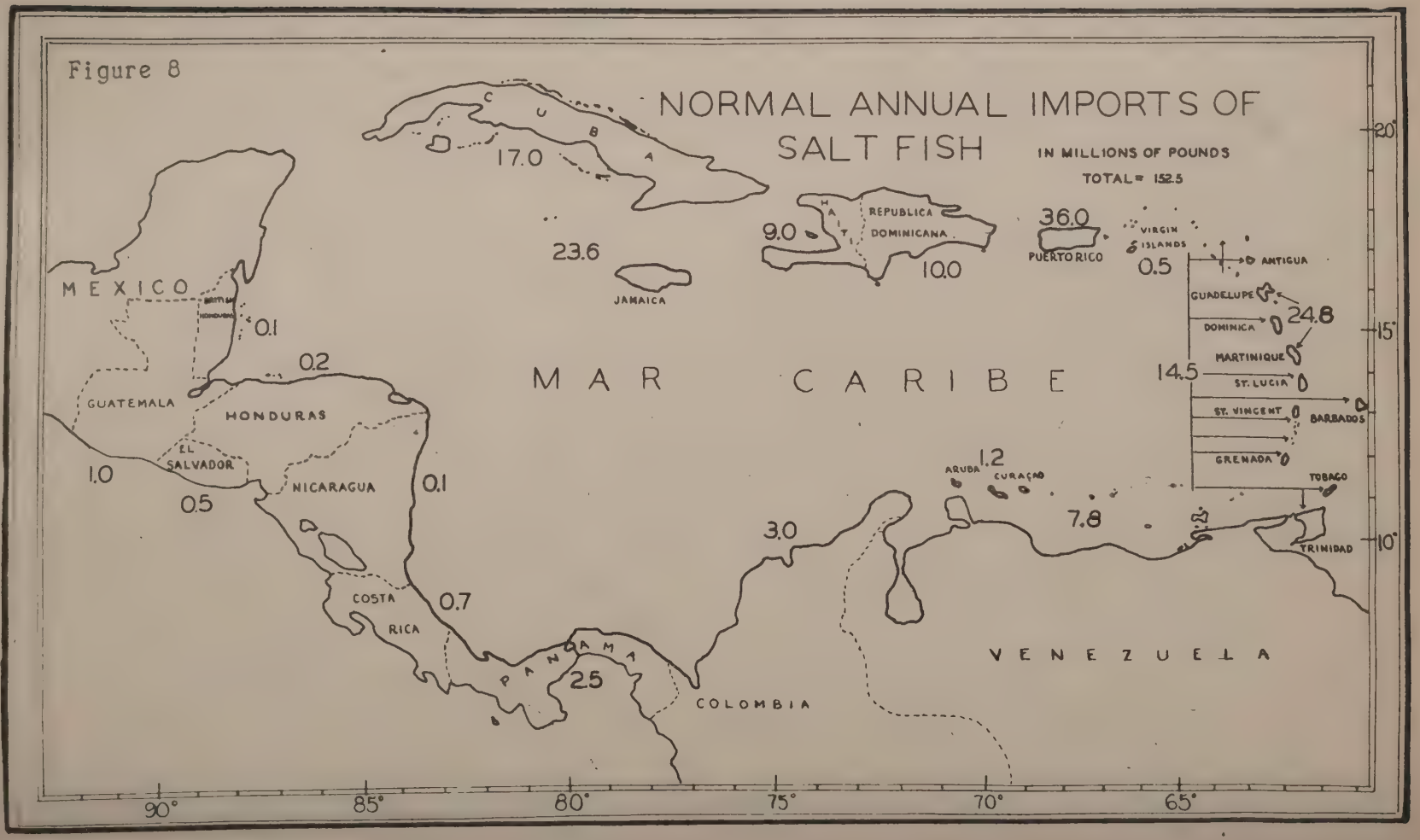


Figure 8
NORMAL ANNUAL IMPORTS OF SALT FISH
IN MILLIONS OF POUNDS
TOTAL = 152.5
CUBA
17.0
HAITI
REPUBLICA DOMINICANA
9.0
10.0
23.6
JAMAICA
36.0
PUERTO RICO
VIRGIN ISLANDS
0.5
ANTIGUA
GUADELUPE
DOMINICA
24.8
MARTINIQUE
14.5
ST. LUCIA
ST. VINCENT
BARBADOS
GRENADA
TOBAGO
TRINIDAD
MEXICO
0.1
0.2
GUATEMALA
HONDURAS
EL SALVADOR
1.0
0.5
NICARAGUA
0.1
COSTA RICA
0.7
PANAMA
2.5
COLOMBIA
MAR CARIBE
ARUBA
CURAÇAO
1.2
3.0
7.8
2.3
VENEZUELA
20°
15°
10°
90°
85°
80°
75°
70°
65°

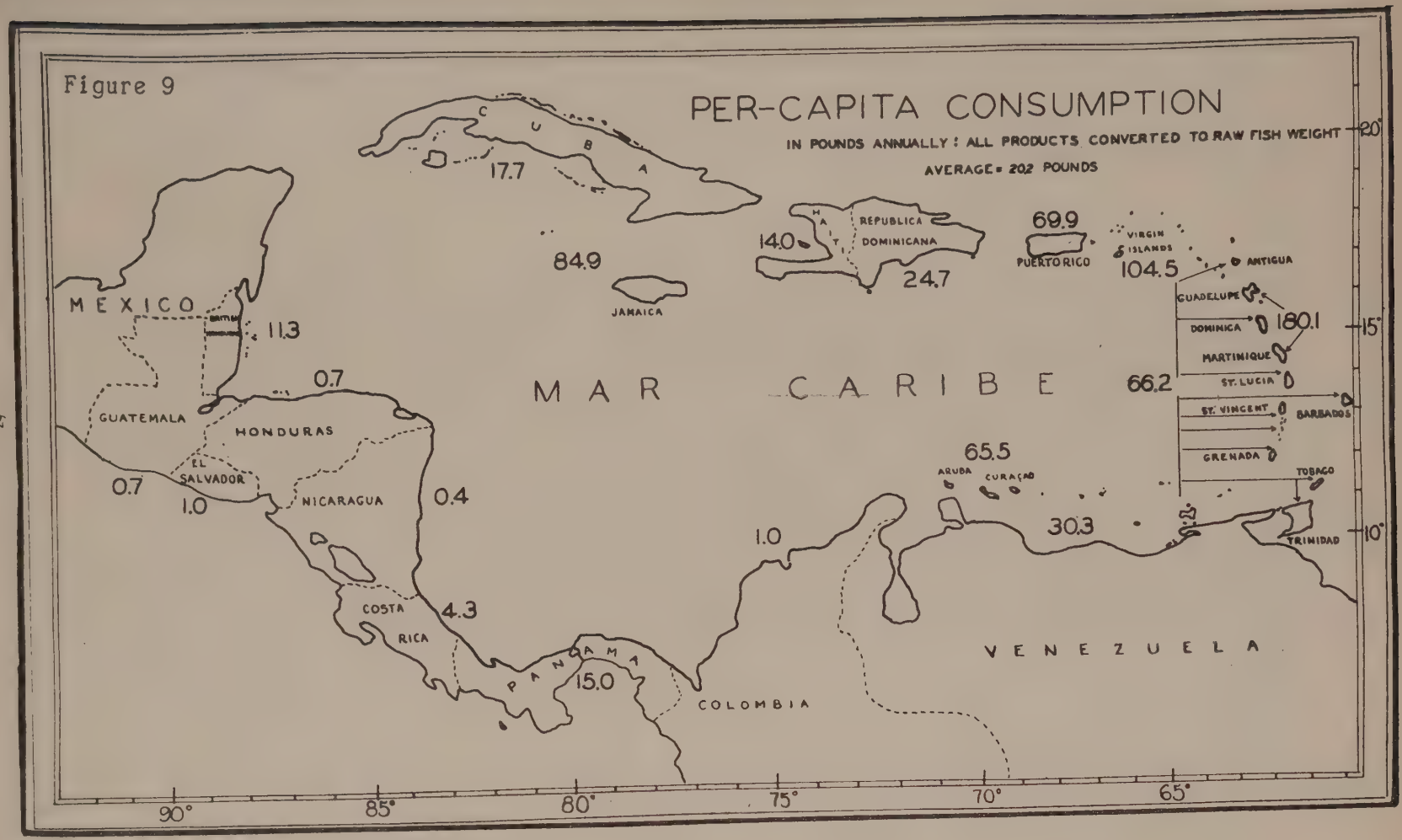


Figure 9
PER-CAPITA CONSUMPTION
IN POUNDS ANNUALLY: ALL PRODUCTS CONVERTED TO RAW FISH WEIGHT
AVERAGE = 20.2 POUNDS
MAR CARIBE
CUBA
17.7
84.9
JAMAICA
HAITI
REPUBLICA DOMINICANA
14.0
24.7
69.9
PUERTO RICO
VIRGIN ISLANDS
104.5
ANTIGUA
GUADELUPE
DOMINICA
180.1
MARTINIQUE
ST. LUCIA
66.2
ST. VINCENT
BARBADOS
GRENADA
TOBAGO
TRINIDAD
65.5
ARUBA
CURAÇAO
30.3
VENEZUELA
COLOMBIA
MEXICO
11.3
0.7
GUATEMALA
HONDURAS
EL SALVADOR
0.7
1.0
NICARAGUA
0.4
COSTA RICA
4.3
PANAMA
15.0
1.0
20°
15°
10°
90°
85°
80°
75°
70°
65°

APPENDIX I

COMMON NAMES OF FISH AS USED IN VENEZUELA AND THEIR ENGLISH EQUIVALENTS

Venezuelan Name	English Name
anchoa	bluefish
arenque	herring
armadillo	gar
atun	tuna
bacallao	cobia
bagre	catfish
blanquilla	ocean whitefish
bocachico	characin
bonito	bonito
burrito	grunt
burro	grunt
cabana	false albacore
cachicato	grunt
cachorreta	mackerel
calamar	squid
camaron	shrimp
candil	squirrelfish
carite	kingfish (western Venezuela)
	Spanish mackerel (eastern Venezuela)
carpeta	mojarra
cataco	sardine
catalana	big eye
cazon	dogfish or shark
cozonete	dogfish
cojinua	jack
corocoro	grunt
corocoro queche	grunt
cuna	snapper
cunaro	snapper
curbina	drum
curbinato	drum
chicharro	sardine
chicharra	scad
chucho	ray
dorado	dolphin
guanapo	snapper
guasa	grouper
jurel	crevally
jurelete	jack
lamparosa	look-down
langosta	spiny lobster
lebranche.	mullet
lisa	mullet
machuelo	thread herring
macabi	bonefish
manamana	characin
mero	grouper
ojo-gordo	(herring) jack
palometa	carangid or characin
pampano	pompano
pargo	red snapper
pargo de piedra	snapper
pargo-guacinuco	snapper
pargo-loro	snapper
pez-espada	sawfish
picua	barracuda
rabi-rrubio	snapper
raya	ray
rey	kingfish (Paraguana)
robalo	snook
roncador	grunt
ronco	grunt
sabalo	tarpon
salmon	goatfish
sardina	sardine
sargo	grunt
sierra	Spanish mackerel (western)
	kingfish (eastern)
tahali	cutlass fish
vieja	sergeant major
zapatero	leather jack

APPENDIX II

GLOSSARY OF TERMS USED IN VENEZUELAN FISHING INDUSTRY

alambre de malla - chicken wire
alambre de cobre - copper trolling wire
alta mar - high seas
ancla - anchor
anzuelo - hook
arepa - corn bread
banco - fishing bank
barco vivero - live-well boat
barricos, barriles - barrels or kegs
bou - trawl net
braza - fathom
buches - sounds (air bladders of fish)
buzo - diver
cayuco - dugout canoe
cabulla - cable or rope
cadena - chain
caladero - ground for hauling beach seine
calado - set of beach seine
caldo de pescado - fish soup
calon - wing (of net)
campana - when fishermen visit temporary fishing grounds
canoa - a dugout canoe
cardumen - school of fish
casabe - cassava bread
chinchorro - large haul or beach seine
compadre - friend (Isla Margarita)
cordel - line
culo de mono - a type of double-ended boat used at Isla Margarita
currican - trolling line
deposito - deposit or depot
filete - gill-net
funche - corn-meal cake
gasoil - diesel oil
goleta - large sailing vessel, schooner rigged
guaral - cotton twine
guapeando - spinning or using live bait or using a lure
guisado - stew
harpon - harpoon
hieladero - freezing boat equipped with ice box
hilo - cotton twine
intermedario - middleman
jonson - outboard motor
lancha - motorboat
lomo - filet of fish
malla - mesh
mandinga - small haul or beach seine
maquinista - engineer
maquina - engine or motor
m'sieu - foreigner
nasa - fish pot
palangre - shark line trawl gear, chain
papelon - crude sugar
patron - captain
peces de bulto - fishes of little or no value
peces de fondo - bottom-living fish
peces oceanicos - pelagic fish
pies - feet
pila - kench

APPENDIX II (continued)

piragua	-	open boats up to 40 foot length, not motorized usually
playa	-	beach
poner colorado	-	to turn red, "reddening"
practico	-	pilot
pulgadas	-	inches
rancheria	-	fishing camp or village
recalar	-	to school
red de arrastre	-	drag-net
red de ahorque	-	gill-net
remolcar	-	to tow
ribazon	-	run of fish
saco or bolsa	-	bag (of net)
salazon	-	fish salting
salado	-	salted
salinas	-	salt works
salmuera	-	brine
salpresa	-	wet salt-fish
secadero	-	fish-drying racks
seco	-	dry
tanques	-	butting tanks
tarrafa	-	purse net
tendedor	-	one who tends drying fish
tendol	-	flake for drying fish
tiempo de cosecha	-	time of greatest abundance of fish
timon	-	rudder
tren	-	unit of fishing effort consisting of men, boats and nets
tres punos	-	medium sailing vessel, sloop rigged
vela	-	sail

APPENDIX III

EXCHANGE RATES; WEIGHTS; MEASURES

1 Bolivar (Bs 1.00) - $0.30 (U.S. currency)
1 kilogram (1 kg. or kilo) - 2.20462 avoirdupois pounds
1 arroba (11.5 kilos) - 25.3 " "
1 quintal (46 kilos) - 101.2 " "
1 tonelada (1,000 kilos) - 2,204.62 " "
1 meter - 3.28083 feet
1 centimeter - .3937 inches
1 inch - 2.54001 centimeters
1 square meter (M^2) - 1.1960 square yards
1 kilometer - 0.62137 U.S. miles
1 U. S. mile - 1.60935 kilometers
1 brazada - 1 fathom - 6 ft.
1 cubic meter (M^3) - 35.314 cubic feet
1 cubic meter (M^3) - 1.3079 cubic yards
1 liter - 0.26418 U.S. liquid gallons
1 U.S. liquid gallon - 3.78533 liters
1 liter - 1.05671 U.S. liquid quarts
1 U.S. liquid quart - 0.94633 liters

SUPPLEMENT

STUDIES ON THE CONTROL OF "REDDENING" IN SALT-FISH PRODUCTS

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INTRODUCTION

The United States Fishery Mission to Venezuela reported that control of the "reddening" of Venezuelan salt-fish products was the most important single prerequiste to their entry into export trade. It was the opinion of the mission that the spoilage of salt-fish by reddening was so serious that large-scale production should be held in abeyance until the control methods used in other countries could be studied and recommendations could be made for the application of preventive measures in the Venezuelan industry. Such recommendations would naturally have to take into account the variations between the domestic and the foreign industry. These differences occur in the preparative methods and equipment, the species of fish preserved, the kind of salt available, the climate, and many less apparent factors.

For many years, one of the most important components of the diets of the people of the Caribbean countries has been imported salt-fish. The shortage of transportation brought about by the war quickly led to a critical and widely-felt scarcity of this highly necessary food. With a view to relieving this pressing deficiency, the mission recommended that the suggested studies be immediately undertaken at the Fishery Research Laboratory of the United States Department of the Interior, at Mayaguez, Puerto Rico.

ISOLATION, CULTURE AND MORPHOLOGY

The spoilage of salted foods, hides, sausage casings, etc., by reddening has been the subject of many microbiological treatises published during the last sixty years. The workers in this field have described several different causative agents and have given various names to the salt-tolerant (halophilic), red-colored microorganisms that infested the spoiled products. Harrison and Kennedy (1922) isolated such an organism and designated it as Pseudomonas Salinaria. This is only one of many such isolations and appellations, but it is not necessary here to review exhaustively the many articles dealing with the topic. Petrova (1935), in studying the characteristics of the infections of various Russian salt deposits, came to the conclusion that the majority of the authors had all described the same bacterial species, but had observed it in different stages of its development. This opinion was based on the marked tendency of the species, as noted also by many other investigators, to modify itself in response to internal and external influences.

The majority of the samples grown in the laboratory showed alterations of morphological and cultural properties. The individuals took the appearance of cocci or rods, and the colonies varied from translucent deep red to opaque pale pink, sometimes changing shades in cycles. There was also a marked inclination to symbiosis with other bacteria. The growth of the reddening organisms is often strongly inhibited in laboratory cultures by concentrations of salt that seem to be easily tolerated under natural conditions. It has been suggested that the symbiotic relationship helps to overcome the repressive effect.

From the review of the literature it was felt that the reddening organisms encountered in Venezuela might be a distinct species, or a modified strain of one previously described. Consequently, it was deemed advisable to study the morphology and cultural characteristics as a preliminary to the testing of control methods.

FIGURE 1.--PHOTOMICROGRAPH OF "REDDENING" BACTERIA (RODS) ISOLATED FROM VENEZUE AN SOLAR SEA-SALTS. GROWN IN 5 PERCENT CODF SH AGAR AT 42°C FOR 2 DAYS. (APPROX. X1 40)

FIGURE 2.--PHOTOMICROGRAPH OF "REDDENING" BACTERIA (COCCI AND RODS) ISOLATED FROM FISH CURED WITH VENEZUELAN SALT. GROWN IN NUTRIENT AGAR CONTAINING 5 PERCENT SALT AT 42°C FOR 2 DAYS. (APPROX. X1140)

Isolation of Organism

Attempts to culture the organism in barracuda fish agar containing 20 percent salt were unsuccessful. Codfish agar was finally used satisfactorily for the isolation of the organism. It was prepared by boiling one pound of dry-salted codfish in one liter of distilled water for one hour, filtering, adding 15 grams agar and adjusting the pH to 7.0. The final salt concentration of the media was approximately 5 percent. The salt samples were ground in sterile mortars, suitable dilutions prepared and one milliliter portions transferred to Petri dishes Dilution blanks were made of distilled water containing 5 percent sterile salt. The codfish agar was then added and the plates incubated at 42°C. for 48 hours.

Most of the colonies were of a white or cream color: a few were pinkish. Subcultures of the latter ones were made on codfish agar slants until pure pigmented cultures were obtained. Miscroscopical examination of stained cultures revealed rods of varying sizes and admixed with a few coccoid cells. (Figure 1.)

It was subsequently determined that the organism grew well on standard nutrient agar containing 5 percent salt. This medium was therefore used interchangeably with codfish agar in later studies.

The organism was isolated from various samples of solar sea-salts from Venezuela, namely, "Coche", "Arraya", "Los Roques" and "La Orchilla". The salt samples were generally of a white or cream color except "Los Roques" which was pink. Total bacterial counts (Table 1) were low and varied somewhat.

Table 1 - Total Bacterial Count of Venezuelan Salts After Incubation in Codfish-Agar Media for 48 Hours at 42°C

Salt Samples	Description of Salt	Bacterial count 1/ Per Gram
"Coche"	Large crystals, white, with dirt specks	2,100
"Arraya"	Medium-size crystals, cream, with dirt specks	7,100
"Los Roques"	Large crystals, pink, with dirt specks	13,800
"La Orchilla"	Large crystals, white, with dirt specks	8,900

1/ Average of two counts; all colonies were white or cream except those from "Coche" and 'Los Roques" in which some pink colonies developed.

Cultural and Morphological Characteristics

In standard nutrient agar containing 5 percent salt, growth was smooth, raised, entire and the color ranged from pale pink to transparent cherry-red. Single colonies in plates occurred as ovoid, amoeboid, mycelioid, and irregular forms. In standard nutrient broth the characteristics were: no surface growth, moderate clouding, flocculent sediment and slight "musty" odor.

The organisms occurred as rods or spheres, were Gram negative and motile, and were without spores. Organisms from primary transplantations into agar frequently had one or two dark spots at the ends, resembling spores. Harrison and Kennedy (1922) attribute this to transitions from cylindrical to round forms.

Optimum Salt Concentration for Growth

To ascertain the optimum salinity of the reddening organism, inoculations were made from a 24-hour old nutrient agar culture containing 5 percent salt to media containing concentrations of chemically pure sodium chloride varying from 0 to 30 percent. One percent agar was added to the media containing the higher salt concentrations (over 5 percent) to prevent solidification at the temperature at which agar is generally poured (45°C.). It was determined (Table 2) that optimum salt concentration for growth was 5 percent. The organism grew slightly in 15 percent salt but did not grow at concentrations of 20, 25 and 30 percent.

Table 2 - Growth of Reddening Organisms at Different Salt Concentrations 1/

Salt Concentration	Bacterial Count of Organism From:		Bacterial Count of Organism From 5% Salt Agar Culture In:	
	5% Salt Agar Culture	29% Salt Brine	Chemically Pure Salt	Solar Sea Salt
0	1,510,000	2,400	60,000	500
5	2,580,000 2/	1,000 2/	64,000 2/	4,800 2/
10	1,400,000	200	1,300	1,000
15	19,000	0	0	0

1/ No growth observed in concentrations of 20, 25 and 30%.
2/ Pink color more pronounced in media containing 5% salt.

It was thought that the successive transplantings through the 5 percent salt medium might have acclimatized the organism to that concentration. Accordingly a new series of media was prepared in the same manner as the previous series, with the salt concentrations ranging from 0 to 30 percent. However, this series was inoculated with organisms that had not been artificially cultured. These were obtained from a pink brine containing 29 percent Venezuelan salt. In spite of having taken the inoculatory material directly from the 29 percent brine, growth occurred only in the media containing 0, 5, and 10 percent salt, respectively. (Table 2)

To determine whether the organic matter, or other impurities, in the sea-salt might stimulate the growth of the red organism, a series of media of varying concentrations of solar and chemically pure salt was prepared for comparative studies. The impure salt evidently had no promotive effect, no growth being observed in the concentrations over 10 percent. (Table 2)

These trials led to the conclusion that a 5 percent salt concentration produced optimum growth of the reddening organism under the laboratory conditions used. These were 48 hours incubation at 42°C. in nutrient agar containing 5 percent salt.

The results of these experiments on salt tolerance confirm previous studies by Stuart, Frey and James (1933) who reported that inoculums from young cultures derived from crude solar salts grew well in media containing 0 to 10 percent salt, but were retarded by concentrations of 12 to 16 percent, and were completely inactivated by concentrations of 24

to 28 percent. Cultures that had flourished in low salt concentration media, which had then been allowed to stand a long time to dry out, yielded inoculums capable of growing in a wider range of salt concentrations than transfers from young vegetative colonies.

The apparent ability of certain strains of the organism to grow profusely in high concentrations of salt, as shown by other investigators (Harrison and Kennedy, 1922; and Stuart, 1940b) may be due to repeated propagation in media of high salt content. In this connection, Rubenchick (1936), having found bacteria that changed their habits from halophobic to halophilic, reached the conclusion that the classification of bacteria on the basis of their behavior in various concentrations of sodium chloride is misleading.

On the other hand, Stuart (1940a) found that bacteria grown in media having a sodium chloride concentration greater than 3 molar (about 17 percent) are materially affected by protein concentration. The addition of small quantities of cysteine to the media stimulated the growth of halophilic bacteria. This effect was especially marked in media in which the salt concentrations were from 3 to 3.8 molar (roughly 17 to 22 percent) and the pH values from 6.6 to 7.2.

Other factors, too, may influence the growth of the reddening bacteria in salted fish. The enzymes present in the raw substrata, or more likely, the microflora encountered in the natural environment, may contribute to the ease with which the reddening organism establishes and maintains itself in the salteries even in contact with saturated brine or solid salt.

Temperature Relations

At the prevailing room temperatures of 25° to 30° C, the organism was found to grow well and to show more pronounced coloration than at 37° or 42° C. However, growth was also good at the latter temperatures. No growth was observed at either 4° or 55° C.

Relation to Free Oxygen

In infected salteries it is often observed that the red organisms will grow profusely at the surface of a tank containing brine-salted fish, but that at a short distance down there is little evidence of their presence. As a lead to a possible method of control, it was thought advisable to determine whether or not the reddening bacteria could live without oxygen.

Accordingly, tubes of agar media, containing glucose and 5 percent salt, were inoculated heavily while in fluid condition at 45° C. After incubation at 42° C a pink ring or pellicle developed on the surface of the medium. No growth was observed in the interior.

Bucher's anaerobic method also indicated that the organism was a strict aerobe. Inoculated dextrose-formate agar tubes were placed inside larger tubes containing at the bottom 4 grams of pyrogallol plus 10 cubic centimeters of 10 percent sodium hydroxide solution. The larger tubes were then tightly stoppered. No growth was observed after several days incubation.

According to a study by Stuart (1940b) the growth of red chromogenic, halophilic bacteria appears to be stimulated by a slight reduction of the oxygen tension. It was suggested that the tendency of these organisms to be strictly surface growers might be a surface tension phenomenon.

Liquefaction of Gelatin

The reddening organism from both the pink and the cherry-red cultures was inoculated into tubes of 10 percent plain and nutrient gelation containing 5 percent salt. Good growth was noticeable in both types of gelatin after 24 hours incubation. After two days incubation, the tubes were cooled in the refrigerator for two hours. All the cultures gelled, showing that much of the gelatin had not yet been transformed. Inoculated tubes containing the gelatin media of either type would not re-solidify after incubation for 15 days, although the cultures were in the refrigerator for twenty hours. Control tubes did solidify

under the same conditions. This indicated that after the longer growth period little or none of the inoculated gelatin remained unchanged.

Chromogenesis

The cultures of the reddening organism varied in color from pale pink to cherry-red. In gelatin media, the coloration was more pronounced when beef extract or peptone had been added. This showed that the protein constituents provided better conditions for the production of pigment. In nutrient agar, those cultures which were grown at the prevailing room temperature of 25° to 30° C exhibited a much darker coloration than those incubated at 42° C. Also, the nutrient agar media that contained 5 percent salt produced growth of deeper color than those containing 0, 10, or 15 percent.

Action on Nitrates

Broth tubes and agar slants containing 0.1 percent potassium nitrate, 5 percent sodium chloride, beef extract, and peptone were inoculated with the reddening organism and then incubated at 42° C for four days. Absence of gas formation was indicated by the lack of foam in the broth tubes and the non-appearance of cracks in the agar slants. The test for nitrite, through the use of sulphanilic acid and alpha-naphthylamine reagents, was negative.

As good growths had been produced in the above-mentioned media, it was felt desirable to determine whether the nitrate had been completely reduced beyond the nitrite stage. The test for the presence of nitrates was carried out by adding a pinch of zinc dust to the tubes to which the nitrite reagents had been added. The characteristic pink color which developed after a few minutes showed that at least some of the nitrate had remained unreduced.

Indole Production

The test for indole was performed by the method of Ehrlich and also by the Gore modification of that method. The medium used was a one percent solution of bacto-tryptone to which had been added 5 percent of sodium chloride. The tests were carried out after incubation at 42° C for one-day and four-day periods. There was good growth in all the inoculated tubes, but the tests for indole were negative.

Action with Various Organic Compounds

To characterize the reddening organism further tests were carried out to determine whether it would produce gas or alter the pH of the substratum when grown in culture media to which certain carbohydrates, alcohols, or glucosides had been added. According to Bergey et al (1939), Pseudomonas salinaria does not produce acid in media containing carbohydrate.

The test compounds were dissolved in approximately four parts of water, and the acidity was adjusted to a pH between 6.8 and 7.0. The various solutions were separately autoclaved for 15 minutes at 15 pounds pressure, and then the containers were plunged into cold water. Sufficient solution was added to the basal media to give a final concentration of the test compound of 0.5 to 0.6 percent, and the pH was then brought to between 6.8 and 7.0. The basal media used were broth and agar, each containing beef-peptone plus 5 percent salt.

Inoculations were made into Durham fermentation tubes and agar shake cultures so that gas production could be detected. These cultures, along with uninoculated Durham-tube controls, were then incubated at 42° C. The organism grew well in all the test media, but it developed somewhat more luxuriantly, forming a surface ring or pellicle, in those cultures that contained l-arabinose, d-xylose, d-galactose, lactose, or dulcitol. After 72 hours of incubation, there were no visible evidences of gas production in either the Durham fermentation tubes or the agar shake cultures.

After 3 and 8-day periods of incubation, the pH values of the media in both the inoculated and sterile Durham fermentation tubes were determined with a Beckman pH meter. The results are summarized in Table 3.

In the cases of seven media, those containing dextrose, fructose, sucrose, maltose, dextrin, mannitol, or d-sorbitol, the pH values of the inoculated tubes fell significantly (0.9 to 1.3 units) below the values of the sterile tubes, during the first 3 days of incubation. During the next 5 days, the pH values of the seeded dextrose, sucrose, dextrin, and mannitol cultures continued to fall slightly faster than the values of the corresponding controls, the differences between the two sets reaching 1.0 to 1.5 pH units. In the cases of fructose and maltose the additional incubation produced almost equal lowering of the pH values in both the seeded and unseeded tubes. However, with the d-sorbitol medium the trend was reversed. During the 5 additional days the pH increased in the inoculated tube and fell in the control. Where at the end of 3 days of incubation the pH of the seeded medium had been 1.08 units below that of the control, at the end of 8 days the difference was only 0.30 units.

The six inoculated tubes that contained l-arabinose, d-xylose, d-galactose, lactose, dulcitol, or salicin showed, after 8 days of incubation, pH values that were 0.5 to 1.3 units higher than in similarly treated controls. However, in the cases of d-xylose, lactose, dulcitol, and salicin no significant differences were apparent from the measurements that had been made after the first 3 days of incubation.

No significant differences between the pH values of the sterile and inoculated tubes were observed in the case of the raffinose medium.

Table 3 - pH Changes Caused by the Reddening Organism in Various Organic Media 1/

Carbon Compounds Tested	pH Determinations After			
	3 Days Incubation		8 Days Incubation	
	Inoculated	Control	Inoculated	Control
l-Arabinose, C.P.	7.50	7.03	8.20	6.86
d-Xylose, C.P.	7.22	7.01	7.60	6.85
Dextrose, U.S.P.	6.12	7.03	5.73	6.96
Fructose, C.P.	6.22	7.17	5.76	6.76
d-Galactose, C.P.	7.06	7.12	7.55	7.05
Sucrose, C.P.	6.22	7.18	5.83	7.03
Maltose, C.P.	6.15	7.27	5.65	6.73
Lactose, Bacto	7.37	7.27	7.46	6.90
Raffinose, C.P.	7.12	7.25	7.16	7.20
Dextrin	6.04	7.32	5.53	7.06
Mannitol, pure	6.25	7.25	5.85	7.20
Dulcitol, C.P.	7.44	7.25	7.75	6.96
d-Sorbitol, C.P.	6.20	7.28	6.53	6.83
Salicin, H. P.	7.12	7.36	7.33	6.86

1/Media consisted of nutrient broth, 5% salt, and from 0.5 to 0.6% of the indicated test compound. A loopful from 24-hour agar slant culture was added, and incubation carried out at 42°C.

CHEMICAL CONTROL OF REDDENING ORGANISM

Most investigators have found that sufficient heat will kill the reddening bacteria. For example, Harrison and Kennedy (1922) recommended that solar sea-salt be sterilized by dry heat at 100° C for 30 minutes in a kiln. Petrova (1935) suggested 120° C for the same time. This method, however, has the great disadvantage that the sterile product may very easily be recontaminated from infected floors, equipment, or storage rooms.

For this reason tests were made of various chemical agents to determine whether one could be found that would inhibit the growth from the time the fish was preserved to the time it was desalted by the consumer. Some salteries have found that the addition of sodium benzoate or boric acid to the salt is of limited value in retarding the growth of the reddening organisms, but in spite of the wide-spread use of these agents, many thousnads of dollars worth of salted fish have been lost each year (Stuart, 1940b).

Harvey (1943) found that 0.3 to 0.7 percent of a mixture of benzoic acid with an equal weight of sodium or magnesium benzoate would inhibit mold growth in kippered fish without

impairing the color or flavor. Potassium nitrate is another agent often used in the preservation of meat products, sometimes in combination with boric acid, borax, and sodium chloride (Leach and Winton, 1914).

According to Frank and Hess (1941), salt-fish was effectively protected against "brown halophilic mold" by being dipped for 30 seconds in an 0.8 molar solution of sodium propionate in salt brine. Macy (1943) reported that sodium or calcium propionate could be safely used to inhibit mold growth in food products for a reasonable period of time.

Since some data were already available on the toxicity and flavor effect of the above-mentioned chemicals when used in food preservation, it was decided to test their action in the control of the reddening organism. First, their ability to inhibit the development of reddening in culture media was determined. Then, when it became apparent that acidic magnesium benzoate, a mixture of equal parts of benzoic acid and magnesium benzoate, was the most effective of the agents tried, that mixture was tested further on the salt-fish itself.

Trial of Reagents in Laboratory Media

A pure culture of the reddening organism was transferred to an agar slant and incubated at 42° C until good growth appeared. A loopful of the culture was then transferred into 30 milliliters of codfish and nutrient broths containing approximately 5 percent salt. The codfish broth was prepared by boiling one pound (454 grams) of dry-salted codfish in one liter of distilled water for one hour, filtering and adjusting the pH to 7.0. Bacterial counts were made on the inoculated broths after 24 hours incubation at 42° C. One milliliter portions of the inoculated broths were seeded into sterile tubes containing 10 milliliter aliquots of varying concentrations of the reagents to be tested dissolved in 5 percent sodium chloride.

The seeded tubes and blanks were incubated at 42° C. After intervals of 10, 30, and 60 minutes and 24 hours incubation, the tubes were removed, thoroughly shaken, and three streaks were made from each tube on plates of codfish and nutrient agars. The streaked plates were examined after 48 hours incubation for colonies of the reddening organism. Growth in three streaks was classified as "abundant", in two streaks as "moderate", in one streak as "scant", and no growth in any of the streaks as "sterile". The lowest effective concentrations of the various reagents producing sterile plates are recorded in Table 4.

The preservative agents tested were: potassium nitrate, sodium benzoate, acidic magnesium benzoate (a proprietary preparation known as "Brino" composed of equal parts of benzoic acid and magnesium benzoate), boric acid, sodium hypochlorite, calcium propionate, and sodium propionate. Table 4 shows what concentrations of the preservatives were tried, whether they made the culture non-viable, and in what length of time this result was accomplished. The acidic magnesium benzoate was by far the most effective control agent, even when used in low concentrations. It was found that 0.1 to 0.5 percent of this preservative destroyed the viability of the cultures of the reddening organism. Boric acid was effective in concentrations of 2 to 3 percent, but its toxicity as reported by Pfeiffer, Hallman and Gersh (1945) would tend to preclude its use in food. Sodium hypochlorite in concentrations of 20 to 100 parts per million also accomplished the extinction of the viability, but in actual use this chemical would probably soon lose its active chlorine, and the salted product would then be likely to be contaminated anew. Sodium benzoate controlled growth only when concentrations above 10 percent were used. This amount was shown by Harsbarger (1942) to be injurious to health and would, therefore, probably not be allowed by the various governmental authorities. Calcium and sodium propionate were tried in concentrations up to 3 percent, which was the highest strength tested by Harsbarger (loc. cit.) that did not prove toxic to rats. Both of these salts were ineffectual in the proportions used. Potassium nitrate, even in concentrations as high as 30 percent, was unable to prevent the growth of the reddening organism.

Trial of Acidic Magnesium Benzoate on Salted Fish

The promising results given by the acidic magnesium benzoate in preventing the growth of the reddening organism in laboratory media suggested that it would be advisable to conduct supplementary experiments using the same preservative preparation under conditions

more like those of the fish-salting industry. Accordingly, a quantity of "grunts" (Haemulon parra and Haemulon sciurus) was dressed in a manner similar to that used in Venezuela. The unscaled fish were split along the backbone, while the belly flesh was left intact to keep the body in one piece. The viscera were removed, and the fish were then washed in a 3 percent solution of unsterilized Arraya salt.

Table 4 - Action of Chemicals in the Control of the "Reddening" Organism

Chemical	Concentration Tested Percent	Bacteria Inoculated in Chemical Solution: Number	Lowest effective concentration 1/ after:			
			10 mins. Percent	30 mins. Percent	60 mins. Percent	24 hrs. Percent
Potassium Nitrate	1, 5, 10, 20, 30	100,000 2/	None	None	None	
Sodium Benzoate	1, 5, 10, 20, 30	100,000 2/	30	10	10	
Sodium Benzoate	1, 2, 4, 6, 8, 10	58,000 2/	None	None	None	
Acidic Magnesium Benzoate	.002,.01,.05,.20,.50,1.50	58,000 2/	None	.5	.5	
Acidic Magnesium Benzoate	.1, .2, .5, 1.0, 1.5	690,000 3/	.1	.1	.1	
Acidic Magnesium Benzoate	.1, .2, .5, 1.0, 1.5	1,000,000+ 3/	.1	.1	.1	.1
Acidic Magnesium Benzoate	.1, .2, .5, 1.0, 1.5	745,000 3/	.1	.1	.1	.1
Boric Acid	.5, 1.0, 3.0, 5.0	100,000 2/	3	1	1	
Boric Acid	.5, 1.0, 1.5, 2.0, 2.5	58,000 2/	2.5	2	1.5	
Boric Acid	2.0, 3.0, 3.5, 4.0, 4.5	690,000 3/	2	2	2	
Sodium Hypochlorite	10, 20, 30, 40, 50, 4/	100,000 2/	20 4/	20 4/	20 4/	
Sodium Hypochlorite	50, 60, 70, 80, 90, 100 4/	58,000 2/	100 4/	100 4/	100 4/	
Calcium Propionate	.05, .10, .50, 1.00, 1.50	690,000 3/	1.0	1.0	None	
Calcium Propionate	.10, .50, 1.00, 2.00, 3.00	1,000,000+3/	None	None	None	None
Calcium Propionate	.10, .50, 1.00, 2.00, 3.00	745,000 3/	None	None	None	None
Sodium Propionate	.05, .10, .50, 1.00, 1.50	690,000 3/	None	None	None	
Sodium Propionate	.10, .50, 1.00, 2.00 3.00	1,000,000+3/	None	None	None	None
Sodium Propionate	.10, .50, 1.00, 2.00, 3.00	745,000 3/	None	None	None	None

1/ Concentrations producing completely sterile plates.
2/ Codfish broth and agar containing approximately 5 percent sodium chloride were used in these tests.
3/ Nutrient broth and agar containing 5 percent sodium chloride were used in these tests.
4/ Parts per million.

Four-pound (1816 grams) samples of the dressed fish were placed in 4-liter beakers, and each sample was salted down with 1.4 pounds (636 grams) of Venezuelan "Arraya" salt that had been previously treated in one of the following seven ways: (1) sterilized by dry heat at 160° C for 1 hour; (2) sterilized and inoculated with 13.6 million reddening bacteria; (3) sterilized, mixed with 4.9 grams of the benzoic acidmagnesium benzoate preparation (equivalent to 0.2 percent of the total weight of fish plus salt) and inoculated with 13.6 million bacteria; (4) sterilized, mixed with 24.5 grams of the same preservative (equivalent to 1.0 percent of the total weight of fish plus salt) and inoculated in the same manner as (4); (5) not treated, used crude and unsterile; (6) not sterilized, but mixed with 0.2 percent (4.9 grams) of the benzoic acidmagnesium benzoate preservative; and (7) not sterilized, but mixed with 1.0 percent (24.5 grams) of the same preservative. In each case where the acidic magnesium benzoate was used, it was thoroughly mixed with the salt before being applied. The fish were arranged so that 4 or 5 in each lot would project above the surface of the brine that would naturally form, and then the containers were covered with cheesecloth.

After periods of 2, 5, and 14 weeks the samples were examined for visible reddening and the pH values and bacterial counts of the brines determined. The results of these observations are listed in Table 5.

After standing for 14 weeks, the samples containing the acidic magnesium benzoate showed no signs of reddening. The same was true for the fish that had been preserved with the heat-sterilized salt. However, the two batches that had been placed in the inoculated sterile salt, or in the crude Arraya salt, showed growth of the red organism on the surface of the brines and in the flesh that projected above the surface. Within these two brines, as well as in the other brines where reddening was not visible, the bacterial count decreased throughout the observation period, until, after 14 weeks, all were nearly sterile. The confinement of growth to the surface, and the gradual decrease of bacterial count in the body of the brine, were further evidence that the organism is an obligate aerobe.

Table 5 - Action of Acidic Magnesium Benzoate in the Control of Reddening During Brining

Brine Treatment 1/	pH of brine after:			Total bacterial count per ml. of brine after:			Reddening after:		
	2 wks.	5 wks.	14 wks.	2 wks.	5 wks.	14 wks.	2 wks.	5 wks.	14 wks.
Sterile Salt	6.15	6.50	6.21	5,400	7,650	20	None	None	None
Sterile Salt + Inoculum 2/	6.31	6.35	6.21	450	1,600	20	None	None	Visible
Sterile Salt + Inoculum + 0.2% Chemical	6.19	6.35	6.00	31,300	50	30	None	None	None
Sterile Salt + Inoculum + 1.0% Chemical	5.97	6.13	5.77	1,000	400	0	None	None	None
Unsterile Salt	6.27	6.80	6.51	545,000	2,950	150	None	Visible	Visible
Unsterile Salt + 0.2% Chemical	6.13	6.23	5.83	100	950	70	None	None	None
Unsterile Salt + 1.0% Chemical	5.83	6.03	5.57	1,250	300	180	None	None	None

1/ "Arraya" salt from Venezuela used in the brine.
2/ Inoculum consisted of 13,600,000 bacteria.

As expected, the pH values of the brines to which the acidic magnesium benzoate was added were slightly less than in the brines not containing the preservative. However, the values for the individual brines did not vary significantly during the observation period.

The acidic magnesium benzoate exhibited some additional and highly valuable preservative effects beside preventing reddening. In all the lots, including the one treated with sterile salt, the fish, especially where they had been exposed to the air, became mushy in texture, stale in odor, and dark brown in color. The brines also assumed the same hue. However, the fish that had been treated with the preservative kept their natural texture and color and had a desirable odor. The brines formed from salt containing 0.2 percent of the preservative were only slightly brown, while those containing 1.0 percent were whitish. These results indicate that the preservative may have additional effectiveness through inhibiting oxidation or inactivating the autolytic enzymes of the fish.

To test the preservative more severely, under conditions more favorable to the growth of the organism, 4 or 5 fish were taken from each sample (after it had been salted for 15 days) and were wrapped in wax paper. After 14 weeks of storage in this manner, reddening developed in all the samples except the one in which the salt had contained 1.0 percent of the acidic magnesium benzoate. The fish which had none of the preservative were again observed to be mushy, blackish-brown, and stale, while the treated ones retained the natural texture and color of fresh-fish and a desirable odor. However, since there was red growth even in those paper-wrapped samples that had been treated with sterile salt or with salt containing 0.2 percent of the preservative, it was evident that although 0.2 percent might be sufficient to control reddening in commercial brine-salted fish, a higher concentration would probably be needed if the handling were careless.

Samples of fish that had been kept for 15 days in the sterile salt and sterile salt plus 1.0 percent of the acidic magnesium benzoate were freshened and fried and then examined organoleptically to determine whether the preservative had imparted any foreign taste. No difference was noted in the flavor of the samples tested. This may have been due to the thoroughness with which the salt and preservative had been mixed.

PRACTICAL CONSIDERATIONS FOR THE INDUSTRY

Processing Methods in Use at Present

Processing methods for the preparation of salt-fish products in Venezuela at present differ from those of other salt-fish producing countries (see main report preceding this supplement). Salteries, as such, do not exist. Every fishing camp (rancheria) is a small unit saltery. Some are equipped with concrete tanks for "butting" fish, others are not. Very few are equipped for shade drying. The lack of fresh water is a serious handicap in salt-fish production. Sea water is used for washing fish previous to salting and undoubtedly is to an extent responsible for reddening. The salting procedure is similar for all species, with the exception of ojo-gordo, lamparosa, cazon and pez-espada, the principal difference being in the manner in which the fish are dressed. The heads of fish usually are not removed as in other salt-fish producing countries since the heads are used in soups, chowders, and in other esteemed native dishes.

Shortly after the fish are landed, they are dressed. The procedure consists of laying the fish on a log, rock, or other convenient object and splitting the head. The split is continued along the backbone from the head to the tail so that the fish will lie flat. The gills, viscera, and abdominal membranes are then removed. A horizontal gash is made under the backbone on the thick side in order to insure good brine penetration. The flesh is scored longitudinally at one-half inch intervals, care being taken not to cut through the skin. The eyes are punctured to release water, and a cross-cut is made in the head just behind the eyes. The dressed fish are washed in sea water to remove blood, slime, and particles of viscera. Scales are not removed. Fish are salted individually. Salt is rubbed first into the cut along the backbone, then into the eyes, head, and other cuts. An additional amount is rubbed over the surface. Approximately one kilo of salt for each three kilos of fish is used in salting. The salted fish are piled flesh side up, in old boxes, barrels, on rock platforms, or on boards, and salt is sprinkled over each layer. After the fish are salt struck (about 24 hours) they are placed in the sun to dry. Average drying time is 3 to 4 days. The fish are often left out at night without cover. However, some rancheria operators, particularly in the Maracaibo area, stack the fish into piles each night and then cover them with burlap bags or canvas.

Flat-sided fish, such as ojo-gordo, chicharra, and lamparosa, are dressed by removing the viscera and gills and scoring both sides diagonally at 1-inch intervals. Eyes are punctured to release the fluid. The fish are then washed in sea water, and salt is rubbed into the belly cavity, eyes, and cuts. The rest of the handling is as described above.

Large sharks, skates, rays, and sawfish are eviscerated and skinned. Then the flesh is cut into longitudinal pieces about 1-inch in thickness. The dark flesh is not separated from the white. The flesh is scored and then washed to remove the blood and other extraneous matter. Salt is applied in the same manner and proportion as for other species. The smaller sharks, skates, rays, and sawfish are not ordinarily skinned. The heads are removed, and the remainder of the salting procedure is carried out as for the other species of fish.

A "light-salted" fish product is also prepared. It is a regular practice among fresh-fish dealers, particularly at the municipal fish markets, to utilize unsold fish for this purpose. Considerable quantities of this type of wet-salted fish also are processed at the rancherias around Maracaibo and elsewhere. The fish are dressed, and a light sprinkling of salt is distributed in the cuts and over the surfaces. Fish prepared in this way may be sold wet or may be partially dried in the sun. In any case, fish prepared by these methods will keep only for 3 or 4 days at the most. The product is considerably more moist than the dry-salted type and contains a much lower percentage of salt.

Very little, if any, brine-salted fish now is prepared and consumed in Venezuela. Other Caribbean countries, however, do consume appreciable quantities of this type of product. Several species of fish such as herring (arenque), thread herring (machuelo), and chicharra (scad) are not now salted in Venezuela. These species and others may be later utilized for brine salting. Species such as Spanish mackerel (carite) and bluefish (anchoa) now

utilized only for dry-salting could also be brine-salted. The Caribbean markets normally import brine-salted fish such as alewives, salmon, herring, and other species, and these meet with excellent consumer acceptance.

Suggested Improvements in Processing Methods to Improve Quality

In view of the findings on the control of reddening, it is believed that the quality of Venezuelan salt-fish products could be markedly improved, and hence storage life prolonged, if certain innovations were introduced in the methods of preparing salt-fish products. First, the solar evaporated salt used in the salting of fish should be improved, and second, the procedure for curing should be altered.

Salt Conditioning

As mentioned in the preceding report, Venezuelan salt has a fair degree of chemical purity. Improvement in chemical purity can be attained by more thoroughly washing out the adhering mud after the salt is removed from the crystallization basins. Conditioning of the salt to improve its value from the other standpoints should be carried out according to the following procedures:

1. Salt should be more finely ground.

2. Salt should be sterilized (100° C for 30 minutes).

3. Acidic magnesium benzoate (Brino) should be added to the sterile salt to inhibit infection by the reddening organism during salting procedure.
   The chemical inhibitor should be added in a concentration of 0.2% of total weight of salt plus fish. Example: If the weight of the salt for each 100 pounds (45.4 kilos) of fish to be salted is 30 pounds (13.6 kilos) the amount of inhibitor to be added to each 30 pounds of salt would be calculated as 130 x 0.2 percent = 0.26 pounds (0.118 kilos). Or for batch mixing, 26 pounds (11.8 kilos) of inhibitor for each 3,000 pounds (1,360 kilos) of salt.

4. Sterilized salt without inhibitor should be used in making up saturated brines for repacking brine-salted fish.

5. Conditioned salt should be packaged in moisture proof containers.

Improved Salting Procedures

Conditioning the salt in the manner described above would allow the preparation in the present fishing camps (rancherias) of improved salt-fish products by practically the same methods that have prevailed in Venezuela for centuries and to which the fishermen have become accustomed. Adoption of the following few suggestions would improve the products of the current dry-salting procedures and would help to make possible the expansion of brine-salting.

Dry-Salted Fish

1. The procedure for dressing and washing as described earlier is satisfactory at most fishing camps. A more thorough washing of the dressed fish to remove blood, slime and extraneous matter is recommended for those camps that carelessly wash the dressed fish. Use freshly caught fish only.

2. A fine grade of conditioned salt containing chemical inhibitor (acidic magnesium benzoate) should be used for salting the dressed fish. At least 30 percent salt by weight of fish should be used.

3. The fish after being struck through with salt should be stacked in piles on frames elevated above the ground and weighted down to press out brine before being placed out to dry (water-horsing or kenching).

4. The salted fish should be more thoroughly dried (5-7 days) preferably in the shade.

5. After drying, the fish should be stacked in piles under cover on frames raised above the ground.

Brine-Salted Fish

Very little brine-salted fish is now prepared in Venezuela, probably because of the short storage life of this type of product. The following procedure is suggested for brine-salting such fish as herring (arenque), thread herring (machuelo), scad (chicharra), spanish mackerel (carite), bluefish (anchoa), mullet (liza), and drum (corbina).

1. Split fish (except herring) along the backbone from head to tail; lay out flat. Use only freshly caught fish.

2. Remove head, viscera and stomach membranes.

3. Make longitudinal gash under backbone on thick portion of flesh side.

4. Score longitudinally at about 1/2 inch intervals.

5. Wash thoroughly, preferably in fresh water. Fresh water could be supplied to fishing camps in water-tight containers in which the fish will be packed.

6. Use at least 30 pounds (13.6 kilos) of conditioned salt containing inhibitor for each 100 pounds of fish.

7. Rub salt well into scores and along backbone.

8. Place fish in layers, flesh side up, in water-tight containers, each layer at right angles to the layer below. Sprinkle salt between layers.

9. Place weight on fish to keep under surface of brine. Strike for 3-6 days (depending on size of fish) in shaded area.

10. When fish are struck through, repack in saturated brine made from sterile salt and fresh water.

11. Head containers and add saturated brine (sterile salt) through the bunghole until completely full.

12. Store in cool, shady place.

For herring (arenque) the procedure is the same with the exception of the dressing operation. Dress by holding the fish in the left hand, belly side down, and cut behind the head in such a manner that the viscera are removed with the head.

Modification of the above procedure can readily be made for large central fish-salting establishments if and when they find a place among the Venezuelan fish industries.

PURE FOOD LAW CONSIDERATIONS

The Pure Food Laws of some countries require that foods containing chemical preservatives be so labeled. Inasmuch as salt-fish products produced in Venezuela for export will undoubtedly find their way into countries that rigidly enforce laws to protect consumers, this requirement must be dealt with. It is believed that the chemical inhibitor recommended is not toxic in the amounts stated. Before using dry-salted fish, for example, consumers soak the fish to remove the salt. This procedure would also remove so much of the chemical that it would cause no deleterious effects.

In the case of brine-salted fish, the chemical would be diluted with the brine used in repacking. However, a statement to the effect that a chemical preservative is used must be made.

In the case of dry-salted fish products intended for export the following sample statement for placement on shipping containers is submitted: Acidic magnesium benzoate added to product as a preservative. Soak in water before using.

For brine-salted fish: Product contains acidic magnesium benzoate as an added preservative.

SUMMARY

Red, halophilic bacteria were isolated from various Venezuelan solar sea-salts. The organism was rod- or round-shaped, pale pink to transparent cherry-red, Gram negative, and motile, and had no spores. Its optimum salt concentration in nutrient agar media was 5 percent, and it liquefied both plain and nutrient gelatin after 15 days incubation. It grew well at room temperature, 37°, and 42° C and did not grow at 4° or at 55° C. It was a strict aerobe, did not produce nitrite or gas from nitrates and did not produce indole. It grew well in media containing carbohydrates, alcohols and glucosides but did not produce visible gas from any of them. It produced acid from dextrose, fructose, sucrose, maltose, dextrin, mannitol and d-sorbitol, high alkalinity in l-arabinose and slight alkalinity from d-xylose, d-galactose, lactose and dulcitol. It did not affect the hydrogen ion concentration of raffinose and salicin.

The action of potassium nitrate, sodium benzoate, acidic magnesium benzoate, boric acid, sodium hypochlorite, calcium propionate, and sodium propionate in the control of the reddening organism in codfish and beef nutrient agar media was tested. Under these conditions the growth of the organism was controlled by acidic magnesium benzoate in concentrations of 0.1 to 0.5 percent, sodium hypochlorite when 20 to 100 parts per million were used, boric acid in concentrations of 2.5 to 3 percent, and sodium benzoate in concentrations above 10 percent. Calcium and sodium propionate and potassium nitrate were not effective in the concentrations tested, which reached 3 percent in the case of the propionates, and 30 percent in the case of the nitrate.

Trials carried out by adding acidic magnesium benzoate to salt during the brining of fish showed that 0.2 percent or 1.0 percent of the preservative checked the growth of the organism without impairing the flavor, odor and color of the fish. The chemical was found to be effective only in the 1 percent concentration when optimum conditions for the growth of the organism were provided.

Acidic magnesium benzoate was noted to have a highly preservative effect in brine-salted fish, and also to exhibit indications of an anti-oxidant effect.

Practical considerations of the findings on reddening control are considered. Processing methods in use at present, as well as salt conditioning and improvements in processing methods to improve quality, are discussed. Suggested procedures are given for the preparation of dry- and brine-salted fish products.

Pure food laws with reference to use of chemical preservatives in fishery products intended for export are discussed.

ACKNOWLEDGEMENTS

Appreciation is expressed to Jose San Miguel and Carmen M. Gonzalez, Fellows in Fishery Research, College of Agriculture and Mechanic Arts, University of Puerto Rico, for their assistance in this work.

LITERATURE CITED

Bergey, D. H., Breed, R. S., Murray, E. G. D. and Hitchens, A. P.

1939. Bergey's Manual of Determinativc Bacteriology. 5th Ed. 1032 pp. Baltimore: The Williams & Wilkins Co.

Frank, M. and Hess, E.

1941. V. Studies on Sporandonama epizoum from "dun" salt-fish. Chem. Abst. 35: 7050.

Harrison, F. C. and Kennedy, M. E.

1922. The Red Discolouration of Cured Codfish. Trans. of Roy. Soc. of Canada, 3rd Series, 16: 101-152, 4 pl.

Harsbarger, K. E.

1942. Report of a study on the Toxicity of Several Food Preserving Agents. Jour. of Dairy Science 25: 169-74.

Harvey, E. W.

1943. Kippered Fish Preservation. Fishing Gazette (New York) 60, No. 10, 64-65.

Leach, A. E. and Winton, A. L.

1914. Food Inspection and Analysis. 1001 pp. illus. New York and London: John Wiley & Sons, Inc.

Macy, H.

1943. Mold Inhibitors for Food Products. Association of Food & Drug Officials of the U. S., Quarterly Bull. pp. 7-12.

Petrova, E. K.

1935. Study of the pleomorphism of the agent producing the reddening of salt-fish. Annales de l'Institut Pasteur 2:255-263.

Pfeiffer, C. C., Hallman, L. F., Gersn, I.

1945. Boric acid ointment intoxication. Jour. Am. Med. Assn. 128, No. 4: 266-274.

Rubenchick, L. I.

1936. Halophilic Bacteria of Salt Lakes. Microbe Variability Conference, 1936: 171-174.

Stuart, L. S.

1940. A. Effect of Protein Concentration and Cysteine on Growth of Halophilic Bacteria. Jour. Agri. Res. 61: 267-275.

1940. B. The Growth of Halophilic Bacteria in Concentrations of Sodium Chloride Above Three Molar. Jour. Agric. Res. 61: 259-265.

Stuart, L. S., Frey, R. W. and James, L. H.

1933. Microbiological Studies of Salt in Relation to the Reddening of Salted Hides. U. S. Dept. Agric. Tech. Bull. 383, 24 pp. illus.

Tressler, D. K.

1940. Marine Products of Commerce. 762 pp. illus. New York and London: Reinhold Publishing Co.

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